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New Screw Press.

We present on this page an illustration of a new screw press to be worked by hand. This press is built by the Ferracute Machine Co., of Bridgeton, N. J., from designs of Mr. Oberlin Smith, and embodies some new features of special interest.

The frame, legs, etc., are duplicates of their foot lever press (F 2) and has many of its parts interchangeable therewith, which, of course, conduces to economy of manufacture.

An especially valuable feature is the encased screw, which is effectually protected from dirt and accidental injury by being placed entirely within the ram, while at the same time the arrangement is such that the weight of screw, wheel and lever is utilized in the downward stroke.

The frame of the press can be inclined to any convenient angle.

NEW SCREW PRESS.

The weight of this machine is about 800 pounds, and its dimensions are as follows: Height to top of frame, 54″; hole through bed, 6″x8″, intersected by an 8-inch circular hole; hole through back, 11 inches; throat, from center of ram back, 6 inches; height, bed to ram, when ram is up, 9 inches; diameter of fly-wheel, 24 inches; weight of same with handle, about 100 pounds; screw pitch (triple thread) 2 inches; screw diameter, 2 inches. The engraving is $\frac{1}{12}$ size of machine.

Special Air Compressor.

We present herewith an illustration of an air compressor designed especially for use on shipboard, and, therefore, with a view to the greatest possible economy of space, combined with high efficiency and reliable working.

Reference to the engraving will show that the machine consists of a double vertical steam engine, with inverted cylinders of the same size, above these being the compressing cylinders, which are single-acting and of different diameters, the air being compressed in two stages.

The air cylinders with their connections are placed entirely within a tank in which there is a circulation of a large amount of water, enabling the air to be delivered remarkably cool, and maintaining a relatively low temperature in the compressing cylinders. Owing to their being constantly submerged, the compressing cylinders are made of brass, and their connections of copper.

For convenience in removing the pistons from the compressing cylinders, the air piston rods have coupling nuts, and the pipe connections are so arranged that the pistons may readily be taken out at the bottom of the compressing cylinders without the necessity for disturbing the tank or its contents.

Having complete automatic oiling and draining arrangements, and a governor, the machine requires the minimum of attention while in operation, and is capable of running continuously and noiselessly.

The machine illustrated is 5 feet 6″ high, occupies a floor space 22″x30″, and is designed to compress air up to 600 pounds per square inch. It is built by the Rand Drill Co., 23 Park place, New York City.

Mr. J. C. Peache, who for many years was manager at Messrs. Willans & Robinson, Thames-Ditton, Surrey, Eng., and who while there worked out and introduced the system of interchangeable parts on which the Willans engine is now built, has lately undertaken the management of the shops and engineering department of Messrs. Davey, Paxman & Co., of Colchester, Eng. In a private letter Mr. Peache says that for making the Willans engine parts absolutely interchangeable as they left the tools he found it necessary to adopt American machinery for finishing some of the finer parts of the work, and for making the many fixtures, special tools, jigs and gauges that were necessary for enabling the parts to be turned out with accuracy and rapidity. He also says he was largely indebted to experience gained in the United States in 1880 in laying out the workshops and machinery at Thames-Ditton.

A Cost-keeping System.

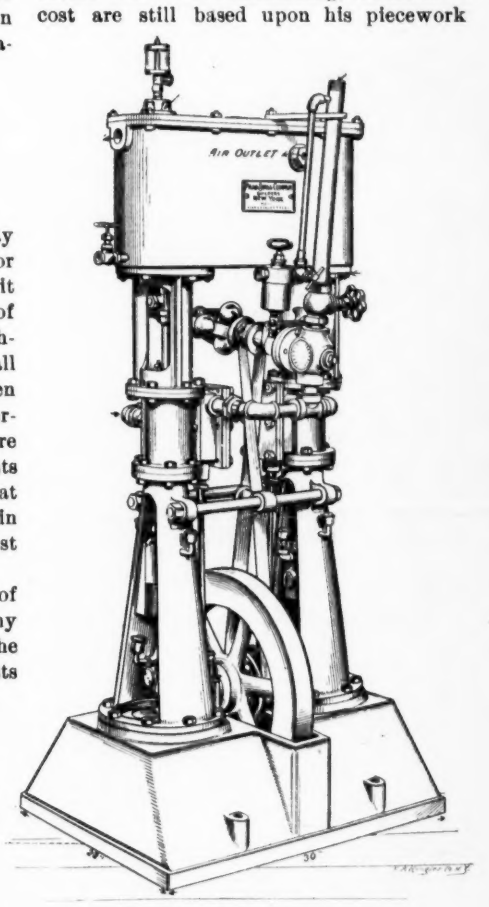
BY WALTER B. SNOW.

No reputable concern at the present day can afford to be without some method for calculating the cost of the articles that it manufactures. Nevertheless, a system of guesswork still exists in many establishments. Approximation, at the best, is all that is sought, and the relation between cost and selling price is left to be determined by the profits of the year. Even where greater refinement in the keeping of costs is to be found, it is frequently the case that only the average cost of articles of a certain class is secured, while their individual cost is still left as a matter of estimation.

A cost-keeping system to be worthy of the name and suitable for adoption in any establishment, should at least possess the elements that will permit of figuring costs in detail upon everything that comes under consideration. It is not sufficient, for instance, in foundry practice to know the average cost per pound of all the cast-iron turned out during a given period, but the cost of the melted iron in the ladle, the cost of pickling, snagging, rattling and handling, should all be known on a basis of their cost per pound of perfect iron castings. Then, with a knowledge of the cost to mold a given piece, or to make for it the necessary cores, it is a simple matter to calculate closely the exact net cost per pound of any finished casting. It is then possible to estimate closely in bidding for new work. The cost of a simple, massive casting requiring the minimum of labor per pound will be clearly shown in its relation to the cost per pound of a thin, complicated and cored piece, and the price may be made accordingly.

Similarly, in the case of a completed machine, the gross cost is frequently known and with reasonable accuracy, but the system employed in obtaining this may have been such as to give no clue to the cost of individual parts and some unnecessary expense, some waste of labor, may remain hidden, whereas it would have been revealed by the employment of proper methods.

Nothing is more misleading than piecework prices where the workman makes considerable variety of articles upon which he receives permanently established prices. This becomes more noticeable as his work increases and he is permitted to employ others to assist him, so that he becomes a veritable contractor. As time goes by he makes certain improvements in his methods until his income exceeds that which his employers are willing to allow him. Then comes a cut, almost to a certainty in the form of a straight percentage reduction on all his prices. After this process has been repeated once or twice, a careful investigation—something to which he may seriously object—will show that his money is actually made on a few of the articles, while others, of which only a small number is required, absolutely cannot be made by him except at actual loss. Notwithstanding, estimates of cost are still based upon his piecework prices, although they no longer represent the actual cost of the piece.



SPECIAL AIR COMPRESSOR.

It is evident that no one general system of cost-keeping can be applicable to all classes of manufacture. It will not do to deal with the collection of costs of a massive machine of which only one is constructed as one would treat the estimation of cost of a small and complicated article made in large quantities. In the one case the single machine must be dealt with in all its details; in the other, figures, although relating to individual processes, must be based upon the aggregate of stock and labor.

The system to be adopted will be largely affected by the methods of the selling department. If goods are made in quantity and prices are substantially fixed, the frequent calculation of costs is not a necessity; on the other hand, where jobbing is done or where prices are based upon the exact expense of filling an individual order, costs must be made up on the completion of the work, but the amount of detail required will depend upon existing custom in that particular line of business.

In presenting the following system it is not expected that it will be found applicable to all lines of trade, but it is the confident belief of the writer that it embodies several of the elements necessary to success in the collection of costs in any ordinary manufactory, although most dis-

tinctively suitable to one constructing machinery in some one of its various forms. It was devised after prolonged study and careful consideration of the conditions and requirements of a business established for over a quarter of a century handling a large variety of work, much of it on piece prices, the majority of the product sold at regular prices and changing but slightly in cost of manufacture, while a certain portion, particularly repairs, necessitated the careful keeping of costs, and the making up of charges therefrom. It was therefore necessary that the system adopted should permit of collecting, at a minimum of expense, all labor and stock data, and should make it a simple matter to figure up at any time and upon any order the exact cost. But, as much of the regular work seldom required any cost calculation, it was desirable that such information as might be collected regarding this line of work should not necessitate any plan of posting to keep it in proper shape for future possible use. For it was, upon first consideration, decided that it would be extremely inconvenient to obtain costs only on certain specified orders. Of necessity the methods adopted had to conform to a certain extent to the rougher system already in existence, otherwise valuable record books and the like would be rendered practically useless.

The early custom had been for the time-keeper to obtain the hours of labor of the men by a circuit of the works near the close of the day. At the same time the order or orders upon which each man had been employed were stated and recorded in the time book with the hours devoted to each. In this condition the time on a given order could be obtained only by going through the entire pay-roll or by daily posting.

This method had been succeeded by a system of time slips daily handed into the office, conveying the same information as above. This was recorded in the same manner.

The first step in introducing the system hereafter described, consisted in the absolute separation of the record of the total hours of labor of the workman, and the record of the orders on which this time was expended. To this end the check system of time keeping was established. At the entrance was placed a board with hooks for 500 checks. Upon each hook was hung a check stamped with a number corresponding to that beneath the hook. Each man as he entered the works removed the check corresponding to the permanent number assigned to him, and deposited it in the box provided. Any one entering the works after the last whistle was required to sign a report to the time-keeper, which was duly stamped with date and hour by the door-keeper. Likewise, if a man went out during working hours his report had to be handed in and properly stamped, this time the inscription reading "left" instead of "entered," all as shown in Fig. 1.

It was next decided that all records of time consumed on given orders should be filled out by the men themselves, countersigned by their respective foremen and collected every morning by a clerk from the office. To effect this successfully it was necessary to introduce a comprehensive system of orders. Shipping orders, which formed, in case of special work, the requisite order for building, were already in existence upon a system of consecutive numbers with the necessary written memos to various departments. But orders to build for stock were in many cases lacking, verbal instructions frequently being considered sufficient. To meet this lack there was established a system of *production orders* upon which all regular goods should be constructed although they might subsequently be shipped on entirely distinct shipping orders. In addition many special articles differing but slightly from the regular were designed to be built on this form of order. Written instructions were deemed to be of vital importance, although it was clearly understood that there might be such a thing as overdoing the matter and encumbering the system with too much red tape.

As the demand for goods in stock was likely to emanate from various sources there was provided a blank form entitled, "Memorandum of Order," upon which the general superintendent might be requested to issue orders to build the specified articles. This form, countersigned by the general superintendent, passes to the order clerk who fills out with as much detail as may be necessary the formal "Order No.———," as illustrated in Fig. 2. This is printed in copying ink, the order is written with an aniline copying pencil or with a typewriter, at the same time manifolding it upon a duplicate beneath. The original is copied in a letter-press record book for permanent consecutive record, and is retained in the office, while the manifold is sent to the department that will finally assemble and complete the given article.

To facilitate the finding of all orders issued from time to time for the same type of article each order is properly entered upon a card and filed in a card index. It is thus possible, by consulting this index, to turn to all orders ever issued for a given article. For instance, there may have been twenty separate orders to build 4x4 upright engines in lots varying from one to fifty. By means of the index the entire list is brought together with orders in consecutive arrangement.

The production orders are numbered consecutively being distinguished from all others by the prefix letter P, as P 1,592.

The necessity of simplicity and explicitness in the production orders led to the *production list* as illustrated in Fig. 3, which represents only a portion of a sheet. This particular list, as will be seen, applies to horizontal automatic engines and comprises a portion of a complete catalogue of all parts and details, all drawings with their numbers, the numbers of patterns and pieces, and the number of each required, together with the designation of material to be used for one complete engine. This list is definitely distinguished from all others by its number T 112. The prefix T indicating the size of sheet, the number showing its relative location in the T size drawers. The separate sheets of the list are distinguished as A. B. C. D., etc., each letter forming a suffix to its respective sheet number. The general designation is given at top of the sheet, thus Fig. 3 reads, "Section A of Production List T 112, continued on B."

By this method the directions for building are simplified to merely specifying the production list, and all notes and schedules upon the drawings are avoided. Minor changes necessitated in the list to fill some special order may be specified in the production order itself, but any radical changes are made upon the original of the list itself, and its number is then changed.

These production lists are printed in a heavy, black ink on thin bond paper, and may be readily blue printed. One blue print is retained in the office and another sent to the foreman in charge of the assembling. When changes are made in the list a record blue print is first made and filed under its then existing number. This provides a reference, so that the changed list may be treated as entirely new with its new number.

To each workman who makes a specific part of the given article—the engine, as

B. F. STURTEVANT CO.

LEFT NOTICE TO TIMEKEEPER.

B. F. STURTEVANT CO. JAMAICA PLAIN 1894 JAN 10 M

Please note this record regarding

Mr. John Johnson

No. 365

Fig. 1.

B. F. STURTEVANT CO.,
Jamaica Plain, Mass.

ORDER NO. P 1592.

OFFICE OF GEN'L SUP'T., July 22 1893

Sup't. Engine Dept.

Six 8 x 12 Horizontal Engines

3 R. H. No. 66 - 68
3 L. H. No. 69 - 71

Production list T 338.

Wanted—Oct. 15, 1893.
Completed———189—

Fig. 2.

8×12 HORIZONTAL AUTOMATIC ENGINE.

B. F. STURTEVANT CO., Jamaica Plain, Mass. SECTION A OF MAY 13, 1893

PRODUCTION LIST T 112 Continued on B.

ERECTION DRAWING 6-353 NAME OF PART.	DRAWING NUMBER.	PATTERN NO. PIECE NO. OR DESCRIPTION	NO. OF PCS.	MATERIAL.
BED	6-216	Pat. 285	1	Cast Iron
CONNECTING ROD.	6-33		1	
Body	"	Pat. X426	1	Steel
Crank Box, Outside Half	"	Pat. 0794	1	Brass
Crank Box, Inside Half	"	Pat. 0793	1	"
Strap	"		1	Steel
Key	"		1	"
Bolts	"	$\frac{3}{4}$"-5 $\frac{11}{16}$" Hex.	2	"
Nuts	"	$\frac{3}{4}$" Hex.	2	C.I. Wrt Iron
Set Screws	"	$\frac{3}{16}$" x 1"	1	Steel
Wrist Box, Outside Half	"	Pat. 0819	1	Brass.
Wrist Box, Inside Half	"	Pat. 0820	1	"
Strap				
Key				
Bolt				
Nut				
Set Screw				
Babbitt				
CRANK.				
Pin				
Plate				
Shaft				
Key				
CROSS-HEAD.				
Body				
Gibs				
Cap Screws				
Studs				
Nuts				
Bushings				

NAME OF PART.	DRAWING NUMBER.	PATTERN NO. PIECE NO. OR DESCRIPTION	NO. OF PCS.	MATERIAL.
CROSS-HEAD (Cont'd.)	6-44		1	
Key	"		1	Steel
Pin (Wrist)	"		1	"
Pin Nut	"		1	Wrt Iron
Nut (Piston Rod)				
CYLINDER.	6-370		1	
Body	"	Pat. 16	1	Cast Iron.
Lagging	"	Pat. 1714	2	"
Machine Screws	"	#14-20 x $\frac{1}{2}$"	28	Wrt Iron.
Studs, Front End	"	$\frac{3}{4}$"x 2 $\frac{1}{2}$"-$\frac{3}{4}$"-14	6	Steel
Studs, Back End	"	$\frac{3}{4}$"x 2 $\frac{3}{8}$"-$\frac{3}{4}$"-12	6	"
Nuts	"	$\frac{3}{4}$" Hex.	12	Wrt Iron
Steam Chest Studs	"			
Steam Chest Nuts				
Head, Front End				
Bushing				
Gland				
Gland Bushing				
Studs				
Nuts				
Head, Back End				
Eye Bolts				
Plugs				
DRIP ARRANGEMENT.				
Elbows				
Unions				
Tee				
Valves				
Piping				

Fig. 3.

TIME CARD ON ORDER NO. P 341

B. F. STURTEVANT CO., Jamaica Plain, Mass. Jan 8 1894

HOURS: 4½

Name of Piece Cylinder

8 X 12 Hor. eng No. 27

Number of Pieces one Tool No. 145

Character of Work Boring

No. 463 Name John Jones Workman.

F. Franklin Foreman

Fig. 4.

STOCK MEMORANDUM.

B. F. STURTEVANT CO., Jamaica Plain, Jan. 5 1894

Please Deliver to Bearer, for Blower Dept.

To be used on Order No. P 361

NUMBER OF PIECES.	ARTICLE.	Weight.	TO BE FILLED IN BY OFFICE. Price.	Amount
4	7/8 x 2½ bolts			
6	3/4 Std. nuts			

P. Peterson Foreman

No article will be delivered from store room without this form of memo. This blank to be used on one order only.

Fig. 5.

B. F. STURTEVANT CO., Jamaica Plain, Mass.

COST SHEET ON ORDER NO. P 1257.

Article 7×10½ Horizontal Throttling Engine Commenced May 18, 1893

Number built 12 Total Cost each ——— Finished Sept. 14, 1893

NAME OF PART OR DESCRIPTION	Piece No.	Material	Pieces each Machine	Pieces built	STOCK OR MATERIAL: WEIGHT ROUGH Total	WEIGHT ROUGH Each	WEIGHT FINISHED Total	WEIGHT FINISHED Each	WEIGHT FINISHED Scrap	COST PER LB. Material	COST PER LB. Scrap	COST TOTAL Rough	COST TOTAL Scrap	COST NET Total	COST NET Each	LABOR TIME HOURS Total	LABOR TIME HOURS Each	LABOR COST Per hour	LABOR COST Total	LABOR COST Each	FINISHED COST Total	FINISHED COST Each	FINISHED COST Per lb.
Bed	Pat 286	C. I.	1	12	53 76	4 48				.025				1 34 40	11 20				16 08	1 34	150 48	12 54	.028
Connecting Rod			1	12																			
Body	Pat X457	St.	1	12	28 8	2 4				.08				23 04	1 92				14 76	1 23	37 80	3 15	
Crank Box	Pat 0777	Br.	1	12	6 3	5¼				.17				10 71	89				4 32	36	15 03	1 25	
" "	Pat 0778	Br.	1	12	5 7	4¾				.17				9 69	81				2 76	23	12 45	1 04	
Strap	6466	St.	1	12	5 4	4½				.03				1 62	14				1 56	13	3 18	27	

Fig. 6.

above, for instance—is given a sectional order upon a blank similar to Fig. 2, but headed "Section of order No. ———." This specifies size of engine, its shop number, the part to be made, the production order number, and the number of the drawing—this latter being taken from the production list. As the foreman of his department has on file a complete set of the requisite blue prints readily accessible, this avoids all possibility of error in misunderstanding on the part of the workman.

To the brass and the iron foundries there are likewise issued, individually, sections of the main order, giving the names and numbers of patterns, and specifying the number of castings required from each.

These latter orders are written in manifold, like the main order, and the manifold copies are attached to and filed with it. Special directions of which an office record is desired are treated in the same manner so that the necessary evidence may be retained.

Orders for patterns are issued on special pattern cost card, as they are usually made without reference to the production orders, and account is kept thereon of stock used and time devoted to each.

Thus far these remarks have applied principally to the office end of the cost keeping. While this detail is, of course, vastly important, yet the correct keeping of the time and stock upon the given orders is of more importance still. The inconvenience of a book record has been clearly shown and it has been stated that in planning this system it was at once decided that the men should be their own time-keepers—subject to countersign by the foremen.

Regular day work is recorded on a time card of type shown in Fig. 4. The blanks properly filled serve to give all the information desired. This card is not intended to be a daily report, but, instead, should furnish a complete record of time and tool employed for any given operation on one or a given number of pieces. Thus, separate reports would be made for the planing, the boring and the facing of a cylinder. The value of thus sub-dividing the record is obvious. The machine tools in the establishment are all numbered, so that the time card properly filled out furnishes a ready means of comparing different classes or makes of tools where used to produce the same result.

A similar card entitled, "Piecework on order No. ———," is used as a piecework receipt and differs from the foregoing in that the lower line is reserved for the signature of the inspector instead of the foreman. These piecework cards are bound up in books of 200 pages each, so arranged that by means of carbon paper the receipt is manifolded; the workman retaining one page in his book, while the inspector tears out the other and turns it in to the office. At the end of the week the pieceworker makes up his report from his receipts, and it is checked by the timekeeper from the cards handed him by the inspector.

To provide for day work by a pieceworker a card entitled, "Pieceworker's time card on order No. ———," is provided, of distinctive color, so that note of same will be made by the time-keeper in order to check with workman's weekly report.

A record of stock delivered from the stock room, or (when so ordered) of the stock consumed by the workman, is reported upon the "stock memorandum" per Fig 5. These cards are provided in two sizes so as to suit requirements.

An "outside time card," when properly countersigned by person in charge of work, is accepted as a record of time spent on the the given job and forms a basis on which to make charges for the work. Besides the hours of labor it covers those devoted to traveling, and indicates the total expenditure incurred.

Men like the engineer, fireman, oiler, lumpers and teamsters, whose work is either specific or so diversified as to make record thereof unnecessary or impossible, are not expected to hand in time cards. The payroll itself serves to give the total time record of these men, and that is all that is desired in the making up of the factor of factory expense.

The system, however, is elastic, and the time of such men may be reported at will upon any job without interfering with existing arrangements. The cards may likewise be filled in to completion, or may only indicate order number and hours worked, with name and number of workman, according to the necessity of the case.

But the vital point in the system consists in the disposal made of these records. The simplest has proved the best—the time cards are filed in separate envelopes by their order numbers. There is thus collected, as the work progresses, a complete record of that work by piece or by day. Reference to this envelope saves a trip through the establishment to see what portions of a given order are completed, and the completion of the entire order is indicated by the presence in the envelope of the main or general order.

Thus a single envelope contains all that is known regarding a given order since its issuance to the shop. Here are filed all memos, notes and sketches, except, of course, such sketches as are regularly filed by their numbers.

It serves as an excellent reference in the future with regard to divergence from, or disobedience of, orders, and is certain to lead to laying the blame for a mistake just where it belongs.

Thus filed, all this information regarding the cost of completing the given order may be allowed to remain, or may be immediately utilized in working up such full or part costs as will serve the purposes of the management.

The time and stock cards themselves may be separated within the envelope according to department, article and process on the same, and the record thus given may be detailed to any desired extent. The formal cost sheet adopted is shown by Fig. 6 (only a portion of the top of the sheet being represented). As many of these are used as may be necessary on a given order, and are then bound up together and filed consecutively by order number for ready reference.

The result thus obtained represents only the absolute net cost, to which must be added the proper percentage of factory or establishment expense. What this factor of fixed charges may be, will, of course, depend upon the character of the business, and still more upon the items which are included in it. The most accurate results will, however, be obtained by charging to the given job or article nothing that it is possible to calculate accurately, and leaving to be incorporated in the factor only those quantities that defy proportional division.

In developing the set of blanks, of which a few have been here illustrated, a basis size of 3″x6″ was adopted for the smallest, viz., the time cards, while larger sheets were made in multiples of these sizes. Thus, the larger stock memorandum is 6″x6″, the memorandum of order, the main order, and the section of order, are each 6″x9″, while the production list is 9″x12″, and the cost sheet 12″x18.″ Because of this uniformity in proportion any one of these sheets may be evenly folded to fit the filing envelope.

Variety in the color of the smaller cards was also adopted to prevent confusion, and to facilitate their assorting after collection.

That the system is perfect as it now stands is by no means claimed, but its failings are so few as to make its adoption well warranted under the existing conditions. It is fully appreciated that the time record of the men is not always accurately stated, and consideration has been given to the idea of noting the time by marking against printed hours, halves and quarters, the time of beginning and ending any given job. Perfection in this line can only be secured by the presence of a time-keeper passing constantly among the men, and recording their time for them.

Greater refinement could be secured in the making up of the cost sheet, but this form certainly is sufficiently detailed for all ordinary conditions. Whatever the failings, however, the foundation has been laid and on it there has been erected a superstructure of system, method and custom, which, substantial enough in itself, may be improved, adorned and embellished at the will of those whom it serves to protect from the evils of an inadequate system of cost keeping.

An Interview With a King.

BY CHARLES T. PORTER.

I once had an interview with a king. It was nearly 30 years ago, but I have not forgotten it. There are reasons, which will appear, why I think an account of it may be of interest to your readers.

In the year 1865, what was termed an International Exposition was held in the city of Oporto, under the patronage of the Portuguese Government. It was projected and carried through by the English merchants residing in Oporto, by whom all its trade was conducted, and who formed a large and wealthy community. The exhibits were mostly British. A prominent feature was an exhibit of machinery. The Manchester firm, who at that time were making the Porter-Allen engine, were the contractors for the iron work of the building, and for the power and shafting. To supply the power, they sent a Porter Allen engine, 14″x30″, making 120 revolutions per minute, and two Lancashire boilers. I went on to attend the opening of the Exposition, and see that the engine was started in good shape.

In order to get the full point of my story, it must be remembered, that at that time there was not a stationary steam engine in Portugal. English enterprise and capital had recently built a line of railway between Lisbon and Oporto, and the locomotives on that line furnished the only exhibition of steam power in the country. To the educated classes of the Portuguese, therefore, the steam engine to be shown at the Oporto Crystal Palace was the object of supreme interest.

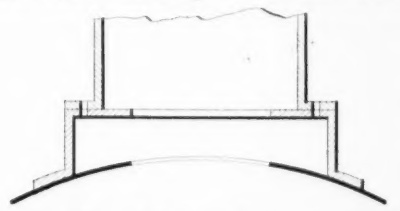
In one respect they used to have on the Continent a way of managing these things which was better than ours. The exhibitions were completely ready on the opening day. For example, in the French Exposition of 1867, which was the last one I attended, the jurors commenced their work of examination on the day after the opening, and completed it in three weeks. The only exception, I think, was in the class of agricultural machinery, which had to wait for the grain to grow. No imperial decree could hasten that. So the Oporto Exposition was to be complete in all its departments when the king of Portugal should declare it to be open.

I arrived in Oporto a week before the day fixed for the opening, and found a funny state of affairs existing in the engineering department. A very capable and efficient man had been placed by our firm in charge of their exhibit. I found his work done. The engine and shafting were in running order. Only the boilers were not ready, in explanation of which I heard this statement: Some time previously an Englishman had presented himself, bearing a commission duly signed by the executive officials, constituting him 'Chief Engineer of the Oporto Exposition," and demanded charge of our engine and boilers, which were all there was for him to be chief engineer of. Our man very properly refused to recognize him, telling him that he had been placed in charge of this exhibit by its owners, and he should surrender it to nobody. But the new man had a pull. The managers were furious at this defiance of their authority. On the other hand, the guardian of our interests was firm. Finally, after much altercation and correspondence with Manchester, a compromise had been arranged, by which our representative retained charge of the engine and shafting, and the boilers were handed over to the "chief engineer."

I was introduced to this functionary, and received his assurance that the boilers would be "in readiness to-morrow." This promise was repeated every day. Finally the morning of the opening day arrived. The city put on its gala attire. Flags and banners waved everywhere. The people were awakened to a holiday by the booming of cannon and the noise of rockets, which the Portuguese send up by daylight, to explode in the air. The king and queen and court came up from Lisbon, and there was a grand opening ceremonial, after which a royal procession made the circuit of the building.

At the hour fixed for the opening, the chief engineer was just having a fire started under the boilers for the first time. I was, of course, pretty nervous, but our man said to me: "You go and witness the opening ceremonies. They will last fully two hours, and we shall doubtless be running when you get back." When, at their conclusion, I hurried through the crowds back to Machinery Hall, there stood the engine motionless. The door to the boiler-room was shut as tightly as possible, but steam was coming through every crevice. I could not speak, but looked at our man for an explanation. "The fool," said he, "did not know enough to pack the heads of his drum bolts; he can get but two pounds of steam, and it blows out around all the bolts, so as to drive the firemen out of the boiler-room." There was no help for it. The boilers had to be emptied and cooled, before a man could go inside and pack those bolt heads.

I must stop here, and explain how a steam drum is attached to a Lancashire boiler, or, at least, how it was in those days. The accompanying section will enable the reader to understand the description. The "drum" was of cast-iron. The upper part, not shown, was provided with three flanges on its sides, to two of which branch pipes were bolted, each carrying a safety valve, while the steam pipe was connected to the third. The manhole was in the top. A cast-iron saddle was riveted on the boiler, and was provided with a broad flange turning inward. This flange and the flange at the base of the drum had their surfaces planed, and a steam joint was made between them with a putty, made of white and red lead rubbed together dry. Square bolt-holes were cored in the flange of the saddle, and



corresponding holes were bored in the flange of the drum. The bolts were forged square for a short distance under the heads, so that they would be held from turning in the square holes. These bolts were inserted from the inside of the saddle, and were packed by winding them, under the heads, with long hemp well filled with this putty. As the nut on the outside was tightened, the putty was squeezed into the square hole around the bolt, and soon became hard. This packing was what the chief engineer omitted. The reader is now prepared to appreciate the situation.

It was not long before the royal procession appeared at the extreme end of the hall, the king and queen in advance, and a long line of the dignitaries of State and Church, with a sprinkling of ladies, following at a respectful distance. Slowly, but inevitably, the procession advanced, between the rows of silent machinery and mad exhibitors, until arriving near us the king stopped. An official immediately appeared of whom the king inquired who was present to represent the engine, or, at least, I suppose he did, for in reply I was pointed out to him. He stepped briskly over to me, and what do you think he said? I defy any living Yankee to guess. With a manner of the utmost cordiality, and speaking in English as if it were his native tongue, he said: "I am extremely sorry that the neglect of some one has caused you to be disappointed to-day." *Me* disap-

pointed! It almost took my breath away. Without waiting for me to frame a reply, (I think he would have had to wait some time), His Majesty continued: "No doubt the defect will be remedied directly, and your engine will be enabled to run to-morrow." Then looking the engine over quite leisurely he observed: "It certainly presents a fine appearance. I expect to visit the Exposition again after a few days when I shall have more leisure, and will then ask you to explain its operation to me." He then turned and rejoined the queen, and the procession moved on, leaving me with food for reflection for many a day. I had met a gentleman, a man who under the most sudden and extreme test acted with a courtesy which showed that he had in his heart only kind feelings towards every one. An outside imitation must have been thrown off its guard by such a provocation as that. In reflecting on the incident I saw clearly that in speaking to me the king had only one thought, and that was to say what he could to relieve my feelings of disappointment and mortification. He had evidently been informed that I could not get any steam, and took pains and went out of his way to do this; showing that degree of kindly and sympathetic feeling that must express itself in act and conduct even towards a stranger. I left the next day for England with some new ideas about the "effete monarchies."

Machine Shop Milling Practice—V.

By Horace L. Arnold.

I do not understand how "V. V." in the American Machinist of December 28th, could suppose I was not aware that both radial and axial, or end and side mills could be used in the same milling machine. "V. V." quotes correctly that "radial and axial mills are two totally different tools, each having powers and conditions which are not found in the other," and I may have said also that the two kinds of mills demanded different milling machines for their best use, because that is what I believe; but the many records I have made in these articles of both radial and axial mill results from the same machine made at the same time, on the same piece, would seem to show conclusively that I did not think it impossible for the same machine to make use of both kinds of mills. It is rather the rule than the exception that a gang of mills has some members which make an axial cut, and others which make a radial cut, both, of course, mounted on the same arbor, and working on the same piece; those mills which act on horizontal surfaces in a horizontal spindle milling machine make axial cuts, while those which work on vertical surfaces under the same condition make radial cuts, as in the very familiar form of a gang of three mills, one of which cuts the top of a piece, while the other two cut the two sides of the piece; the top mill cuts axially, and the two end or edge mills cut radially.

But if "V. V." understood me to say that radial or end mills were unsuitable for use in overhung machines of the Brown & Sharpe index class, I failed wholly in expression, because the radial mill only needs a very small part of the support which the axial mill demands, and hence for machines which do not rigidly support both ends of the mill arbor the end mill is the better tool of the two.

The time made in finishing the six sides of each of the 8-inch cubical die blocks was good, and was made under the following conditions:

The face mill was made with plain, round-bodied teeth, held with screws in plain round holes in the mill body, and cut so as to have an inclination of about 5 degrees, making the angle of the face of tooth to the work of about 85 degrees; outside diameter of circle of teeth, 8.4 inches; 40 teeth, 20 revolutions, and $\frac{3}{4}$ feed per minute, giving these figures:

Surface speed of mills, 44 feet per minute.
Feed per minute, $\frac{3}{4}$ inch.
Teeth per minute, 800 —.
Cut per tooth, 0.0011 inch nearly.
Cuts per inch, 914 +.

I was informed that there was only one cut taken over each side; if this was the case, and the feed was started before the mill touched the work, and kept on until the mill cleared the work, the length of each of the six cuts was about $32\frac{5}{10}$ inches, say, 33 inches, and there were six such cuts, making the total cut 198 inches, which at $\frac{7}{8}$ inch per minute would require 3 hours 49 minutes. As the job took 6 hours and 25 minutes, 2 hours 36 minutes were used in setting the work on the machine. It will be noted that the feed per tooth was extremely fine, only a little over $\frac{1}{1000}$ of an inch ($\frac{11}{10000}$ inch), which is not one-tenth part so much as the same cutter might do with rigid support and a flooded cut. The machine was a large heavy tool of the Brown & Sharpe type, and I should judge it to be very well fitted throughout.

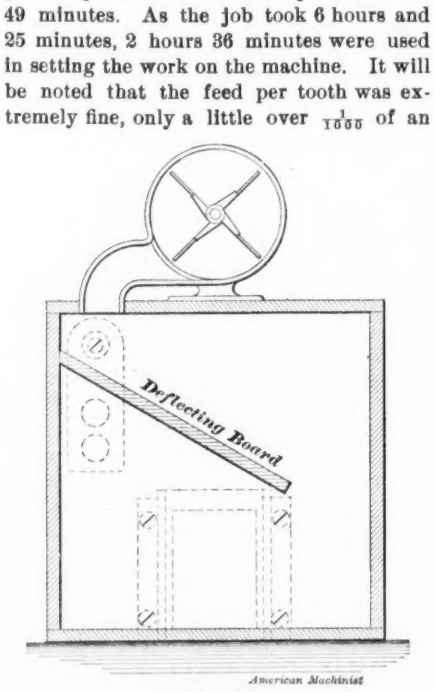


Fig. 32

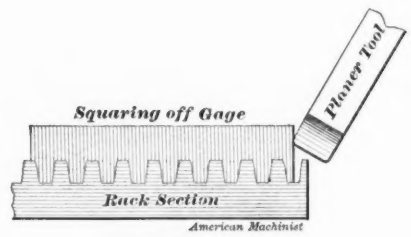


Fig. 33

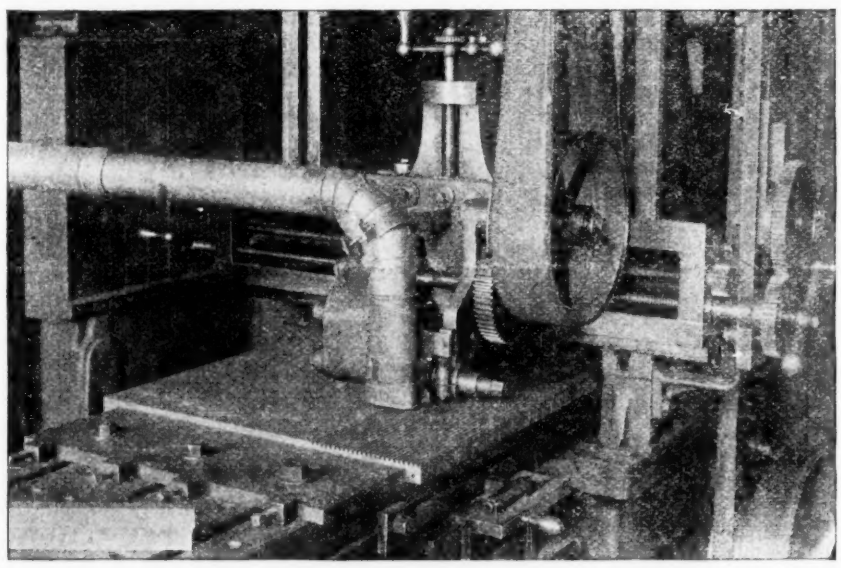


Fig. 31.

One of the most complete milling jobs at the Pratt & Whitney shops is the rack cutting for the engine lathes. It is one of the most instructive also, because it involves what is, so far as I know, an entirely new feature in removing the chips as fast as made by means of air suction, and this suction which was applied solely to remove the chips has the unexpected effect of greatly prolonging the life of the mills. Like almost all really perfect mechanical operations this present method of making the lengths of lathe rack has been of slow growth. Twenty-eight years ago Mr. Edward R. Faxon began to be a planing contractor in the Pratt & Whitney shops, and cut the lathe bed rack sections. At first the teeth were planed in, with a single-point planer tool, and a line of graduation on the planer cross-rail to govern the spacing of the rack teeth. This method was pretty raw, and the racks produced by it were not marvels of accurate machine work; the shape of the tooth was a matter of some uncertainty, because it was difficult to grind the tools, and the spacing was not all that could be desired, and at the end of four or five years, or more, the planer tools were changed for a gang of four mills, and a couple of countershafts were added overhead to reduce the planer bed travel from 20 feet to $1\frac{3}{4}$ inches per minute; the three countershafts were so arranged and belted that while the forward motion was reduced to $1\frac{3}{4}$ inches per minute, as stated, the original backing speed of about 40 feet per minute could be had, and, of course, if the chips were not carefully cleaned out of the last made cuts they would pack under the mill teeth as the bed made its fast idle return and break the teeth off the cutters. Mr. Faxon pondered over this matter and finally in the fulness of time added a Sturtevant blower to the plant which blew the chips away from the cutters as fast as made; this did away with cleaning out the cuts carefully by hand, and also powdered that whole end of the shop most liberally with fine cast-iron dust, so that all the oil holes in that neighborhood were filled up and had to be dug out regularly, the belts all slipped, and all the hands in the vicinity could have gone on the minstrel stage without the application of burnt cork, at the close of any sweaty day. So Mr. Faxon thought again, and turned the fan pipes around, and added a telescoping suction tube, all as seen in the illustration herewith, and put a chip box under the fan, with a sliding door to give the sweeper a chance to shovel the chips out, and now all the observer can see of this job is the mills running along into the solid stock without a visible chip anywhere, so that at first sight the feed seems to be stopped, and the cutters running altogether idle. As soon as this rig was at work it was discovered that the mills were good for many more lineal feet of cut with one grinding than ever before: partly, as is supposed, because they are kept perfectly cold by the strong current of air, and partly, and mainly, I should say, because the friction and grinding up of the chips is altogether avoided. When the work is fed against the mill revolution, as it is in this case, and is cutting a comparatively deep groove, the groove packs full of chips, and when the mill teeth come down into this groove the spaces between the teeth fill solid with already cut chips, and in this condition the tooth and space meet the cut which forces more chips into the already filled and crowded space between the teeth. All this trouble went away when the suction was put in, and now the job goes on, still, clean and pleasing in every particular, and the cutter lasts much longer, and the work is also much better than ever before.

In the foreground of the engraving of Mr. Faxon's application of air suction to milling cuts a pair of rack lengths are shown with their teeth closed together, so that they seem one piece of metal.

As these rack sections are made in great numbers year in and year out, it is interesting to note the seemingly incongruous series of operations in their manufacture; they are first milled on four sides, each section being 2 feet long by $1'' \times 1\frac{3}{16}''$; they next have a planer cut on three sides, the two cuts on the edges being made on a fixture, so that the back of each piece is a little wider than the opposite side in which the teeth are to be cut; then they are put on the planer table where the teeth are to be milled in, 55 at one time crosswise of the planer table, and held with screws against a wide bar bolted to the planer table making a wide vise, and a planer cut is taken over the fourth side. The object of the very slight taper (not more than $\frac{1}{4000}''$ or so) is to give the 55 sections a tendency to form an inverted arch on the planer table, so that they all lie down solid. After the planer cut over the tooth surface the mills are put in, the planer table is driven about $1\frac{3}{4}$ inches per minute, and the teeth are cut at two cuts, roughing and finishing; then the planer works as a planer again to square off the ends at the middle of a tooth space so that the racks will match when touching endwise. Hence there are first four milling operations, next four planer operations, then two milling operations, and finally two planing operations, a total of 12 operations, of which six are performed by planing, and six by milling. The average time on a lot of 55 of these rack sections is 57 hours, or very nearly one hour each section, or a labor cost of perhaps 12 or 14 cents each, as one hand tends two machines.

It is not convenient to carry the chips far away by the suction, and they are, therefore, delivered directly into a box close beside the planer on which the fan stands, constructed as shown in Fig. 32. The chips are led into the top of the box through the fan discharge pipe, and strike a deflecting partition, inclined, down which they slide to fall into the bottom of the box. Two dovetailed battens are screwed to the front of the box, and retain a sliding door, which is lifted out to give access through the door to the chips to clean the box. At the left-hand corner under the deflecting board are two air release holes, covered by a pivoted drop shutter; this can be used to reduce the air pressure in the box, which in escaping carries some fine iron dust with it, and the holes are at the farthest point in the box from the air entrance, and so give the longest possible air travel, and hence most chip depositing time possible with this arrangement. The iron dust in the air close to the box was not obtrusively noticeable, but there was plenty of it there, as a fine deposit of iron powder on all articles very close by showed. But it was not so abundant, nor did it travel so far as to cause any inconvenience whatever. It would not seem that a volume of air sufficient to efficiently remove the chips from four fast cutting mills could be so easily disposed of in a small box, but it is, and the whole simple arrangement stands greatly to the credit of Mr. Faxon.

The cut of 48 inches long was made in 28 minutes, or almost exactly $1\frac{3}{4}$ inches per minute; the mills were $3\frac{1}{4}$ diameter, running 52 revolutions per minute with 40 teeth, giving the following results:

Surface speed of mills, 44 feet.
Feed per minute, $1\frac{3}{4}$ inches.
Teeth per minute, 2,080.
Cuts per inch, 1,188.
Cut per tooth, 0.00084 +.

It will be noted that on this day in and day out job the mills are fed against the cut; the speed of the mills is at least double a fast ordinary planer speed, and the feed per tooth is unusually small, while the results are in every way extremely satisfactory.

The last operation is to cut off the ends of the racks with a planer tool, so that they will exactly "match up" when the sections are screwed end to end in place on the lathe

beds; that is, so that they will preserve the pitch of the rack teeth perfectly when abutting. To effect this, the planer squaring-off tool is set as shown in Fig. 33, by the use of a "squaring-off gauge," made of a section of the rack itself, and having one end, *both* ends, I think, in the actual gauge, squared off accurately to the precise middle of a tooth, and placed in the teeth of the racks to be squared, as shown. By this simple and certain method, the tool is set so the racks squared off by it match perfectly.

I have been thus minute in the detail of this rack job, because it is the first application of air suction, and because it is the result of many years' practice at piecework prices, and has been carefully considered throughout, and because it is such a very surprising mixture of planing and milling operations. It will be noted that, except for the irregular surfaces of the sides of the teeth, all *final* operations are planer cuts, and that, except in squaring off the ends, the planer tool finally finishes the work previously surfaced by the mill.

A building and loan association has just been incorporated in Illinois under the title of the Illinois Savings and Loan Company, of Chicago. The capital is given as $10,000,000, and 20 shareholders are said to be ready to take an aggregate of $100,000 worth of stock. The organization will have branch offices in every important village, town and city in Illinois.

The foregoing, which is taken from a daily paper, is interesting as showing modern tendency towards centralization in such matters. It ought to be, by the application of a little thought, instructive as well. There is no assumption that this Illinois institution is not honest in its organization, or that it will not be honestly conducted. That remains to be seen. But it sails, or proposes to sail, under borrowed colors, so it seems. Building and loan associations are the effort at co-operation by workingmen with the prime purpose of securing homes for themselves, and with the secondary consideration that those who do not want the home shall benefit those who do, without injury or with profit to themselves. The capital is the aggregation of small sums paid in regularly by a good many members, and the profits go to these members. Poor men come together, the business is managed at very little cost, and the profits are kept in the family, as it were. This can hardly be the case with the large, imitative concerns in which money is invested for speculative purposes. Expensive offices must be created and paid for; capital is invested for the purpose of money-making, and in some way it will be made to do so.

As intimated, this projected association may be honest enough, but it is something quite outside the regular building and loan association which has so much of good to its credit. There has been lots of trading on the credulity of workingmen, based more or less on the success of building and loan associations. Whenever an outside scheme is proposed, it stands them in hand to look closely at the manner in which it is hedged around by safeguards, and then to consider the probability of its offering as great advantages as the local institution.

It does not matter what a man's occupation may be, if he does anything to speak of he will sometimes make a mistake. But the consequences of that mistake bear an intimate relation to his occupation. If a machinist once in a while spoils a job, which he is sure to do if he knows anything, the consequences can generally be measured by the standard of a few cents or dollars. "Chordal" went almost to the limit when he pictured a careful man leaving a monkey-wrench in the cylinder. This might be rather costly in its consequences, but taking the general average of his shortcomings in the way of mistakes it wouldn't pay to unravel much red tape to the end of avoiding the possibility of their occasional occurrence. The wear and tear of the tape would cost more than the saving.

When it comes to railroading, or steamboating, or running a powder-mill, or something of the sort, the case is different. A mistake is likely to result in loss of life, which is quite another thing. Then it comes to be that every known appliance should be employed to keep the individual from making mistakes.

Unfortunately, the value of a human life in many States is fixed at five thousand dollars. Nothing more senseless was ever done. It is a direct incentive to common carriers to avoid expenses to bring about security to life. It is cheaper for them even to kill outright than to maim. Certain well-known safety appliances, in railroading for example, can be weighed in their cost in dollars and cents against the probability of paying so many times five thousand dollars, and a pretty fair presumptive balance can be struck. The side that foots up the cheapest is the side that prevails.

If instead of this, when a railroad disaster results from a failure to furnish well known safety elements, the cost of killing passengers was made high block signals would pay and rotten bridges would be out of date.

Not long since I went through a cotton-mill in an eastern city, in which the piping was a poem in its way. The main steam pipe ran along by a long row of boilers, with in takes on a line with the bottom of pipe and easy drip back, special elbows everywhere, with great easy bends and other fittings to correspond. The main steam pipe came into the engine room, and terminated in a breeches pipe, the branches facing right for each line of the twin compound engine; everything in all the large system of piping planned right and made right without a makeshift visible anywhere; the pipe finely covered, and not a leaky joint to be seen in the whole.

There may be a question as to whether or not such work is economical, but I don't believe there is. It cost something for the skill that planned the arrangement, and it cost more in place than a cheap job, but no engineer will let steam go to waste through leaky joints in such an arrangement of piping, and there isn't in all probability joints that have to be jacked together to make and then go right on neutralizing the best efforts to keep them tight.

If there wasn't another thing to be said in favor of such piping as this, it pays just as well as a picture on the walls of a living room, but there is more to be said of it; it is a good job, and a good job is generally the cheapest.

In the large power engine rooms of the city above referred to—and there are a good many of them—a striking feature is the ample room. The engineer isn't cooped up in little 7x9 quarters that wouldn't look comfortable, or be comfortable, whatever he tried to do to make them so. His engine room is large and probably in every way the most comfortable room in the building, provided with a desk—perhaps two—and all the facilities required for keeping things going satisfactorily. I don't know which comes first, that is, whether the facilities provided for the engineers make good men of them, or whether the good men make good engine rooms and appliances. At any rate the two seem here to be found together, probably purely and simply because it pays. Good work and good workmen in illy-suited, uncomfortable quarters don't go together. There is lack of what the chemist would call affinity.

Riding recently on one of the large steamboats that go and come between New York and other points, the antics of one of the main pillow blocks had a peculiar fascination for a well-known mechanical engineer acquaintance. It went endwise and up and down with a sort of circumlocutionary compromise motion between the two ways—a sort of wandering around, as it were, to reach the limit in the four directions.

When you look at some detail of a steam engine that does not keep still when it ought to do so, it seems to go in the way of crookedness a good deal more than it really does go. About a half-inch seemed to be a reasonable limit at which to place the aberrations of this pillow block, but exact measurement would undoubtedly make it less. The shaft in this case turned only thirty times a minute, and was probably kept fairly cool by the use of a little water occasionally. If the speed had been sixty revolutions, or more, with the modern stationary engine running it in that way would have been an immediate failure. That being so one is led to wonder how much the unnecessary work of moving around the shaft and attached weights from and to undesirable positions really cost. It was an absolute nightmare to this engineer whose constructive ideas centered on shafts and other things that "run true."

Naturally enough, the opening of the Manchester ship canal was the cause of much comment and considerable rejoicing in England. It was a great enterprise, well carried out, and will be of immense advantage to a large manufacturing section in the way of reducing freights, permitting goods to go both ways and by sea without the cost of loading and unloading, and aside from this securing to manufacturers and consumers cheaper local service. Railway freight tariff in England is high as compared with this country, and already the effect of opening the canal has been the reduction of charges by competing railway lines. It is, however, a hopeless task for the railways to attempt to compete with the canal except when they can gain a point by quicker delivery. In nearly all great European countries much attention is being given to artificial waterways, and in every instance of completion the result appears to show the wisdom of doing so. It was at one time the boast of great railroad men in the State of New York that the time was near at hand when grass would be seen growing in the dry beds of the canals. If this were fulfilled, it would be of incalculable damage, not only to the State of New York, but to the whole country. Certain freights can, if the facilities are good, be carried cheaper by water than by rail, and no doubt this will always be the case. There is little or no chance for monopoly in canal transportation, and the canals are a healthy restraint upon the railroads.

A press dispatch announces that a recent test of cast-steel projectiles made by I. G. Johnson & Co., of Spuyten Duyvil, N. Y., proved these projectiles to be equal to every requirement. These cast shells tried were 10″ diameter, and were fired into nickel steel armor plates 10″ thick, which they passed through, and were found practically uninjured. This is a very remarkable performance for a steel casting, and if it can be surely duplicated, means a very great saving in cost of projectiles.

In these and past days of phenomenal depression in our trades and industries generally, and during the all-pervading laments over current bad times, it is indeed a relief and consolation to be able to record one, at least, refreshing exception. We are pleased to learn that the number of applications, in this country [England] for Letters Patent during the past year, which has just closed, has attained the unprecedented total of 25,102, or nearly 1,000 more than during the previous year, which then held the record. Such a steady increase or uniform improvement in the patent applications, indicating a healthy development of the inventive faculty of our people, is certainly highly encouraging and gratifying.—*Invention.*

A recent report of the American consul at Amoy, China, has this interesting piece of information: "In selling his goods the Chinese merchant in silverware gives the weight of the metal, its fineness, and its value as bullion, and then as a separate item the cost of the workmanship. Thus a bill for a pair of corded bracelets was as follows: Silver (4½ ounces 85 per cent. fine), $4.20 (Mexican); workmanship, $2.15; total, $6.35 (Mexican). The first item is mathematically correct and can be depended upon as the intrinsic value of the material used in the manufacture." There is a Confucian flavor of honesty about this bill that does abundant credit to the much-despised Celestials, and an explicitness in detail that the advance in civilization seems to have made impossible in more up to date and much prouder nations.—*The Keystone.*

LETTERS FROM PRACTICAL MEN.

To Make the Castings Sound.

Editor American Machinist:

In regard to Mr. W. H. Drake's castings, if he would raise the runners so to have more pressure on the casting, and pour the mold with good hot metal, he would get rid of those holes, providing the sand in cope is of even temper. D. J. RENAUD.

Editor American Machinist:

Perhaps an experience of some twenty-three years making steam and water boilers for both power and heating purposes, should give me the right to answer the inquiry of W. H. Drake in your issue of the 18th inst. But answering such a problem without examining the casting is a good deal like doctoring patients without seeing them. I can say that in all my experience I have never seen a blow-hole that I was satisfied came from the iron, although I have often had molders try to lay the blame of them to the metal. Blow-holes are generally caused by gases from either the mold or cores, or else by the chaplets used to hold the cores; the last, especially if of wrought-iron, will cause trouble, unless carefully cleaned of rust and protected from the dampness of the mold.

I have sometimes seen shrink holes which, to one not familiar with the foundry, might be thought to be caused by a blow, but no molder should have any trouble in distinguishing the difference. In the case mentioned I should certainly look for the trouble in either the core or molding-room.

Speaking of blow-holes brings to mind an incident that shows the almost inconceivable strength of cast-iron when properly supported.

At the time of the Centennial Exhibition in Philadelphia, I was making boiler sections for the Exeter Machine Works, of Exeter, N. H. They wished particular pains taken with some to be sent to the exhibit. They were all carefully looked over, and tested with 500 pounds hydraulic pressure. After delivery to the Exeter folks they pickled all of them, and tested them again; after being set up at the Fair, and being run during the whole time when being cleaned of the soot, the scraper broke into a blow-hole near a chaplet, about 1½ inches in diameter, not over $\frac{3}{64}$ inch thick next the water, and perhaps twice as thick on the outside (the whole casting was ⅜ thick.) This thin piece of casting that a light hammer could easily break had twice stood a pressure of 500 pounds, and then carried a steam pressure of 150 pounds or more, without any sign of giving out.

If Mr. Drake does not find the cause of his trouble, if he will write me directly, giving a few more particulars as to shape of casting, etc., I will gladly give him any help in my power. H. C. WILLIAMS.

Foxboro, Mass.

Editor American Machinist:

In answer to Mr. Drake's request for information, in the AMERICAN MACHINIST of January 18th, in regard to holes in castings, would state that in the first place I should try how they would act by pouring, say, from 25 to 50 pounds of iron through the mold after it has been filled; the hot iron running over the core will have a tendency to warm the top of the core so that the iron will lay on it still and not kick, as I think that is the reason of the blow-holes. And, another way might be tried, that is, if the cope is 6″ deep, bush the gates up 2 or 3 inches higher so as to put more pressure on the casting, and if the core is not too hard

and close, with a good opening for the vent to come off, it will be all right. I do not think that the holes are due to the quality of iron used, as I have seen cases of that kind before. And I would pour them as hot as possible, as dull iron is an enemy to good castings.

If Mr. Drake wishes to experiment a little, he can get one of the cores, or a slab made out of the same sand, and bed it in the floor or in a flask, and pour some iron on it, and he will soon see what the difficulty is if the core is not open and dry. As soon as the iron strikes it it will commence to bubble and blow, and the gas from the core gets under the iron, and just before it sets the gas is not strong enough to blow through the iron, consequently it leaves those blow-holes under the iron that are so much trouble to Mr. Drake and others.

THOS. WATHEY.

Editor American Machinist:

The holes in the boiler castings spoken of by W. H. Drake in your issue of January 18, 1894, are caused, I think, by gas escaping off the surface of the core into the metal as the top part or the head of the boiler is being filled with iron.

This will occur from a number of causes, such as dull iron, improperly vented cores, etc., but in this particular instance the trouble probably lies in a lack of pressure on the iron in the mold; this is brought about by slow pouring and risers that are too large.

In large risers, or risers at all in this instance, the air in the mold escapes as the iron enters, thus relieving the pressure, and with the latter released bubbles in the iron do occur on account of the slight resistance offered. With no risers, the iron entering the mold displaces the air by pressure through the sand and vents, causing at the same time a pressure on its own surface which prevents bubbles.

This is readily proven by ramming a plate casting, say, 12″x20″ medium hard and pouring it in open sand; as there is no pressure on the iron, the vent comes up through it and forms bubbles, which would be permanent in a plate ½″ thick. If the same mold is covered with a cope, the pressure of the incoming iron prevents the formation of bubbles by driving the vent off through the sand or core if the latter forms the bottom part of mold.

Slow pouring, or "bringing up" a casting slow, has the same effect as risers, *i. e.*, it releases the pressure, and in doing so, in the case at hand, would form bubbles. Now, if the castings or molds in question are filled right up or poured medium hard as the iron is filling up the head of the boiler, bubbles cannot very well occur in the manner mentioned by Mr. Drake. ALEX. CAIRNS.

Indicator Reducing Gear.

Editor American Machinist:

I suppose I ought to have felt a twinge of conscience when perusing Mr. Richards' animadversions on "Fault-finding in Indicator Literature," instead of which I shall have the audacity on the present occasion to indulge in a few critical comments on the pendulum reducing gears described by your contributor in the issue for January 4th. Mr. Richards' Figs. 1, 2, 3 and 4 are, as he says, absolutely correct gears, but, at the same time, I do not think engineers will be enamored of the majority of them.

One of the objections to ordinary slot reducing gear is the liability of lost motion occurring and affecting the movement of the drum. But with reasonable care in setting up in the first instance, the gear will run some considerable time before the wear of the pin fixed in the crosshead is sufficient to introduce appreciable error in the card, owing to the resulting lost motion being diminished in proportion to the reduction of motion effected. But with Mr. Richards' Figs. 1 and 2, we have quite another condition of affairs, for here, in addition to the reduced lost motion just mentioned, we have the full effect of any "play" which may exist in the upper slots, brought to bear directly upon the movement of the indicator drum. The same remarks apply, in a somewhat lesser degree, to Mr. Richards' Fig. 4.

Again, in these gears there is the additional trouble and cost of making the second slot, and also the necessity for providing correctly-placed bearers or carriers for the sliding bar. As Mr. Richards is doubtless aware, it frequently taxes all one's ingenuity to find a suitable fixing for *one* fulcrum pin, without having to provide some means for carrying the supports for the sliding bar. Of course, for permanent gears this may be arranged for, without much difficulty in most cases, but the question arises, Why make use of such inconvenient devices at all? Compare, for example, Mr. Richards' Fig. 2 with the Fig. 2 of my paper (November 23d issue). Assuming Mr. Richards' two guides to be fixed so that the movement of the sliding bar is quite horizontal, that there is no lost motion in either slot connection, and further, that the cord is led in a perfectly horizontal direction to the indicator drum—his gear will have the advantage over my Fig. 2, of keeping the direction of the cord in one fixed straight line, thus obviating the error due to the rise and fall of the cord pin *P*. Under ordinary circumstances, the latter effect would introduce an error in the movement of the drum of *less than* 0.00001 *inch*. Can Mr. Richards' double-slot gear give as good a showing in practice as this? I think not.

Again, with the sliding-bar arrangement we are practically restricted to one length of card, while with the simple pin connection, it is easy to modify the drum movement as required. The gear shown by Mr. Richards in Fig. 3 has been often used, but I fail to see why one should trouble to rig up fixings for the sliding bar when precisely the same result can be much more readily obtained by the addition of a link parallel and equal to *B C*, connecting *E* with a point in the link *C D*, and as indicated in my Fig. 5. It is surely desirable to make such gear in as simple a manner as possible, consistent with accuracy, and it is undoubtedly advisable to dispense with sliding bars and other friction-creating devices, if the same result can be obtained by free linkage.

Finally, I must express a hope that the large proportion of our indicating engineers, who are either ignorant of, or, as Mr. Richards has it, indifferent to, reducing gear errors, will find some wisdom in this multitude of counsel. M. E.

Two Eccentrics on Corliss Engines—An Indicator Diagram that Shows Something Wrong.

Editor American Machinist:

I note in your report of the Engineers' Meeting that in Mr. Hemenway's very interesting talk he alludes to the use of two eccentrics on Corliss engines, and that the E. P. Allis Company used them in 1886 on the low-pressure cylinders, but did not recommend them on others, or high pressure side.

The writer commenced the agitation of two eccentrics in 1877, but was met with opposition from engine builders as well as from engineers.

At that time I had attempted to get a Harris engine in such shape as to give a reasonably correct card. During the different changes they were kept up long enough to determine the amount of coal used, and the quantity of coal burned was taken to decide the merits of the different changes.

There was no gain in economy from cushioning, and journals would heat with lead. There was a saving from early exhaust, but to get it sufficient required an angular advance of the eccentric to such an extent as to add so much lap to the steam valves as to shorten the governor's action and seriously cripple the engine for doing its ordinary work. As it was very evident that the Corliss engine with one eccentric was incomplete when used with a condenser, an effort was made to induce some one to have two eccentrics put on some new engine, and note results, but the effort failed.

In 1883 I was placed in a position where the experiment could be tried.

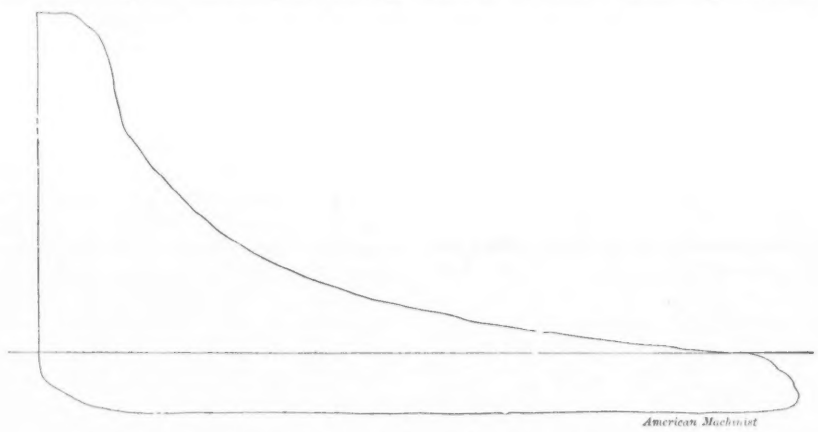
The objects sought were to set the exhaust valves so that sufficient cushion could be given to overcome the inertia of the reciprocating parts, to give sufficiently early release to bring the exhaust right down to the full vacuum line at the commencement of the stroke, and to have all lap of the steam valves removed when the eccentric was at right angles to the crank.

It is needless to say that all of this became easy with the separate eccentrics and an account of it, with cards, was published at the time so that all interested might have the benefit.

The following year the Corliss people were asked to put one on a 30″x60″ engine of their make, but refused, as they did not approve of it and did not want their engines run that way, so it was put on by another party.

A compound engine was afterwards purchased, and, very foolishly, the builder was allowed to build it with only one eccentric on the high-pressure side, and when load was put on the low pressure would empty the receiver, as the contracted range of valve movement on high-pressure side would not furnish sufficient steam. In this case the receiver was supplied in addition with the exhaust from two steam pumps.

Since that time care has been taken to specify two eccentrics on all cylinders and the manner of splining the valve stems, and any of the Corliss engine builders will put them on if specified and insisted upon.



AN INDICATOR DIAGRAM THAT SHOWS SOMETHING WRONG.

With this is a card taken from a Corliss engine 28x72 with steam jacket and two eccentrics.

A glance shows that something is wrong. If the engine is at fault it must be one of two reasons.

The high terminal pressure and long drawn out compression line would indicate excessive clearance.

But it is known that the piston comes to within less than ⅛″ of both cylinder heads, so that cannot be it.

It could also be caused by a leak in the steam valves, and a larger leak in the exhaust valves or piston, but it is difficult to suppose such a case in a new engine.

The same thing could be caused by an incorrect indicator motion, or, by a correct motion and stiff drum spring with a stretchy cord.

What do your readers say is the trouble?

W. E CRANE.

Four-Valve Engines With Independent Steam and Exhaust Valves.

Editor American Machinist:

I observe that the question of the moment seems to be, judging from the reports and correspondence appearing in the columns of the AMERICAN MACHINIST: Who introduced the four-valve engine with independent steam and exhaust eccentrics, and at what date?

I think the first engine put on the market, of this class, was the Greene engine, patented by Noble T. Greene, in 1855, and built at about that time by Messrs. Thurston, Gardner & Co., of Providence, R. I., the predecessors of the Providence Steam Engine Company, now building the same engine in the same place. But the idea may not have been new even then, for Mr. George H. Corliss has frequently told me, in conversations relating to the development of his engine and its rivals, that he had often thought of the plan of using that arrangement on the Corliss engine, but that he did not like to lose that element of safety, which is now found in that machine, as he built it, which comes of the fact that, should a steam valve "stick up," the return movement of the latch would close it and prevent the engine "blowing through" on the opening of the exhaust, and refusing to take up its regular action later. The Greene engine has always been so constructed as to give a full stroke or "plug-tree" action to the steam valves, with the usual movement of the exhaust valve. This is accomplished by its inventor, either by the use of two eccentrics or by taking the motion for the steam and exhaust valves from points on a single eccentric situated about 90 degrees apart on its circumference. The latter gives a peculiarly ingenious and compact valve connection. By either arrangement the engine may cut off anywhere from the zero point up to very nearly full stroke. I have myself designed these engines with cut off varying between zero and 0.85 stroke; though I doubt if there is any advantage in an adjustable cut-off, in most cases, reaching beyond three-quarters stroke. Mr. Greene, who is still living and working with all his old interest, can probably furnish more particulars and a minute history, to any one interested in the matter sufficiently to make inquiry.

R. H. THURSTON.

A Correction.

Editor American Machinist:

I see that I have made an error or omission in my letter on packing rings in your issue of January 18th. It was my intention to say that Fig. 12 was full size for a 2″ or ⅛ size for a 16″ ring *when made by two circles*. I made Fig. 12 by first drawing a 2″ circle, then on a vertical center line marked off the distance *a* (as shown in "Bell Crank's" figure in your issue of December 14, 1893). Then allowing .06″ for the thickness of the ring opposite the cut, drew the inner circle. This will make the thickness of the ring at the cut .0354″, and happens to be almost exactly *three times as thick as it should be (for uniform deflection) 10° back from the cut*. I had no intention to question the accuracy of his table of thicknesses for various parts of the ring, or to misrepresent the eccentric ring.

If "Bell Crank" constructs his rings with irregular lines, he should designate it a *cam* ring. J. H. DUNBAR.

Bolt and Nut-making Machinery.

Editor American Machinist:

I find in your valuable paper a letter signed P. Auriol, asking if you will kindly send him the addresses of the best American bolt and nut machine makers; he also ends his article by saying: "Bolt-forging machines generally in use here are old style, giving a pretty good production but bad forging, and all the good bolts and nuts are still made by hand. Naturally, machines combining both large production and good quality of forging will certainly find a good market in France." In one sense this request is a little surprising. I wish to state that there has been in this country for the past year a Frenchman by the name of Edmon Baville, who brought with him from France several bolt and nut finishing machines, lathe chucks, tool-holders for slotting machines, lathes and planers, etc., etc.; also drawings of several machine tools. These drawings represent tools, which the said

Baville claims have been made in France and Belgium under his personal direction, one of the machines being a milling machine, which the said Baville states takes the place of twelve of the best milling machines made by any American firm. Now, as all these machines, tools, etc., have been made in England, France and Belgium for a few years past, and he is now in this country trying to make Americans believe that he has the best machines ever invented or constructed for finishing bolts and nuts, also a new system of threading dies, etc., etc., and, as I have personally seen these Baville machines, I desire to ask Mr. Paul Auriol if he will kindly inform me to what extent these Baville bolt and nut threading machines are meeting with success in France; when he answers this through the columns of the AMERICAN MACHINIST, then I will have more to say upon the subject. C. E. SIMONDS.

Cambridgeport, Mass.

CRITICAL NOTES.

Engine Speed Limitation—Honing Tools—Milling Machine Feed.

Editor American Machinist:

In the AMERICAN MACHINIST of November 9th, 1893, A.F. Keffo criticises the opinions of the writer, on "The Limitation of Engine Speed," and I desire to correct some statements as to what I said in the article. He writes that I assert "that the clearance space in a non-condensing engine can be filled by compression so that the waste room is not the cause of any loss of steam." What I wrote was, "any serious loss of steam." He further writes that I state that "all the force exerted in compressing the steam to fill the waste room is reacted on the piston." The actual words were as stated, but followed by, "save that which is dissipated in friction caused by the act of compressing." Thus it will be seen I am quoted as making two unqualified assertions which I did not make. I always admire frank and courageous criticism backed by logic and facts, but I seriously object to being incorrectly quoted. It is rather curious that any one will put himself on record in print by misquoting in such a way, for it is so easily detected by any one who cares to refer to the original.

In the AMERICAN MACHINIST of November 2d, 1893, Mr. Gribben gives some very interesting points about honing lathe and planer tools, which will be fully appreciated by all machinists who are capable of doing fine and accurate lathe work, but there are many good sized machine shops in this country, in which no machinist is ever seen doing any honing, except when his jackknife gets so dull it will not cut plug tobacco or a leather belt, and then he will go and grind it, and finish its edge off in good style on some patternmaker's elegant and carefully cared-for whetstone. There is philosophy in this whetstone business if you will only look for it, and if machinists had to furnish the physical force which holds their tools up to the work as patternmakers do, you would observe among them a very great interest in having good whetstones so their tools could be kept as sharp as possible.

I can testify from my own experience that it pays to whet even a cold chisel if you want to get the very best service from it, and the finest grained and best whetstone that can be had will give the best results.

About a dozen, more or less, of your correspondents have told us more or less elaborately why it is that a milling cutter works so much better when the material is fed opposite to the direction of the cutter teeth motion. Some fellow went at it and run cutters that way, possibly without any theorizing about it, and found they worked better than in the old way, and it is very nice to have everybody come up smiling and tell why it is thus, but what a pity it is that our hind-sight is so much better than our fore-sight. Just think what a grand thing it would have been, if about twenty years ago some genius had risen up and covered himself with glory by telling us that we had been started in the wrong direction and explaining to us why we should run the other way. Now the unwelcome suspicion steals upon us that there may be a great many other things we are doing which are regarded as strictly correct, which, after all, may prove to be wrong. Mr. Morton has demonstrated that a shaper will do more work when cutting the other direction, and I suppose it will not be long until some one proves to us that our lathe tools must be turned the other side up and the lathe run backward. We are also probably hammering the wrong direction on our cold chisels. Of course it is all right and in the line of progress but this merciless tearing up of old beliefs somehow goes hard with me and I cannot help wondering "where we are at"

Your contributors, Lister & Co., "Quirk," and Professor Sweet, touch on the vital point about milling machines in general, when they refer to the weakness of the cutter arbor and in many cases general weakness of the machine. If a machine which is of a heavy substantial design will do more cutting with the work fed in the opposite direction, then it will be a good thing, for it will hasten the destruction of the old flimsy machines. The milling machine has had strong advocates for a number of years past, who have claimed that it is capable of doing more work of almost any kind than could be done by planing or shaping. It has also made an excellent record on some classes of work, yet it has made but little headway in getting into some classes of the best shops.

Several years ago a glib-tongued salesman stopped at the shops of one of the most noted engine building firms in the country and persuaded them to buy a universal milling machine, making them believe that they could do all the work on it much cheaper and better than they had been doing it on shapers.

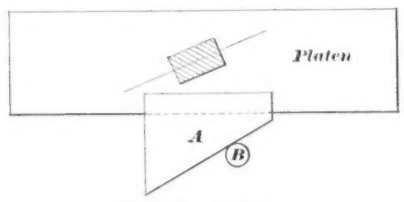
This machine was one of the best of its kind in the market at that time and had all the attachments for doing all kinds of work. Their previous experience with milling machines was limited to that of an old plain miller of the architectural style, that had one cutter on it which was used for keyseating small shafts. They put the new machine in the charge of one of the best machinists about the place so as to give it a fair start. After giving it a trial of several months they found the work was costing more than it had cost to do the same kind of work on shapers, and if they crowded it so it would turn out an equal quantity of work, then the product was not accurate enough to serve their purpose. They are doing all their work yet without the aid of a milling machine. There was evidently a mistake here of some sort, and the cause of failure was simply that a machine of that kind was not adapted to their work. The fact is that even the best universal milling machines of the present day are not adapted to removing large quantities of metal rapidly and accurately, their chief value being that many kinds of work can be done upon them that cannot be done on other machine tools without the assistance of much hand skill. You could not expect much execution from a machine built as they are. On examining one of them we find a knee gibbed to the front face of a comparatively narrow column, and adjustable vertically thereon. On top of this narrow knee a saddle is gibbed, and this is adjustable in another direction. On top of this is gibbed a narrow working table, which is fed in another direction. On top of this table is perched the appliances for holding the materials to be operated on. Above this is the cutter in the middle of a long thin arbor. Along with most of these machines also comes an elegant and dainty little chuck with a round base and a central pedestal which elevates the jaws three or four inches above the table. Then there is the graduated rotating head adjustable to any angle and equipped with a screw on its spindle for chucks and other fixtures. Now imagine this spindle pointing heavenward and holding something on it to be milled, and the joint between that and the table, and the joint between the table and the saddle, and between the saddle and the knee, and between the knee and the column, and the various distances from joints, and thence to the fine-toothed cutter on the slender arbor thereof, all combined as specified and for the purpose set forth, and how much metal would any sensible mechanic expect it to nibble off per hour?

The man who went around selling that kind of a machine to engine builders to make engine parts, was doing about the best thing possible to kill the milling machine business with them for years to come.

The universal milling machine is a very useful and valuable tool in its proper place and so it is with the milling process in general, but there are a large number of excellent mechanics who do not seem to know this and think that almost everything made in a machine shop could be milled to shape cheaper and better than any other way,

There is plenty of room for missionary work yet introducing milling operations in machine shops but the missionary who succeeds must know his business thoroughly, or he will do more harm than good.

BELL CRANK.



Milling Spirals.

Editor American Machinist:

Having received a great deal of information from your valuable paper, in return will endeavor to contribute my mite which may interest some of your readers, especially H. W., in issue of January 4th, Question 6. In regard to milling a spiral without being able to swivel table, set the centers at the required angle on the platen, or if the platen is not wide enough for the amount of angle, mount the centers on a separate plate and fasten the whole on the platen at the angle required. Make a piece *A*, as shown in sketch, from plate-iron, about ¼ inch thick and fasten to platen. Fix a stud *B* with roller at its end to some stationary part of machine so it will bear against plate *A*, then remove cross slide screw and apply a weight to keep *A* in contact with *B*. If now the platen is fed forward and the work is revolved, the piece *A* will cause the cross-slide, and with it the platen, to move to the left, keeping the cutter in its relative position to the axis of the work. The plate *A* and stud *B* may be reversed by fastening roller on platen and plate *A* on machine.

A. MERTES.

Says the Form of Inserted Tooth Milling Cutter is Not New.

Editor American Machinist:

I notice in Mr Arnold's article of January 11th, that the Pratt & Whitney Co. have applied for patents on the form of inserted tooth mill there illustrated. We have had the identical form in use in our shop for fully three years past. The idea, as far as our shop is concerned, originated with Mr. S. E. Freeman, our foreman at that time.

A. FALKENAU

Circumference of a Circle.

Editor American Machinist:

In reply to Query 43, let M M. P. multiply diameter by 355, and divide product by 113, and he will have circumference nearer than if he multiplies diameter by 3.1416; as $1 \times \frac{355}{113} = 3.1415929$. This method is very simple and exact. WM COX.

Season's Commerce at the Head of the Lakes.

The past season has been the greatest in all respects ever known at the head of Lake Superior. The lumber trade record is a phenomenal one. Those who were considered liberal a year ago estimated the shipments for this season at about 50,000,000 feet against 30,000,000 feet in 1892. The total for the year foots about 115,000,000 feet, showing a gain over the shipments of the year preceding of nearly 385 per cent. For the first time the extreme head of the lakes, Duluth and Superior, figured as an ore shipping point during the past year. The docks of the Duluth, Misaba & Northern road at Oneonta handled 426,000 tons of ore and the Allouez bay docks of the Duluth & Winnipeg road at Superior, Wis, shipped 81,000 tons, a total of 507,000 tons. This is certainly a great record for an initial year. The flour traffic shows an increase of about 38 per cent. over the shipments of the preceding season. The shipments amount to 6,129,000 barrels, of which 1,527,000 barrels were manufactured by the mills at the head of the lakes. Receipts by rail from interior points for transshipment amounted to 4,667,000 barrels, against 3,749,000 barrels during the season of 1892. The total shipments of flour in 1892 by lake amounted to 4,475,000 barrels.

The wheat shipments were 33,167,000 bushels, an increase of 1,163,000 bushels over the shipments of the previous season of navigation. Receipts of wheat during the season amounted to 26,703,000 bushels, against 28,989,000 bushels in the same period of 1892. Receipts of coal were 100,000 tons in excess of the receipts in 1892. They amounted to about 2,000,000 tons. The season of 1892 lasted 224 days, while that of the present year, opening May 9th, contained 208 days, counting the closing day, December 2d, when the last cargo left. Reckoning the close with the last arrival, the "John M. Nicol," the season contained 211 days. Arrivals and departures from both Duluth and Superior numbered 5,400 vessels, including small boats engaged in Lake Superior trade. Excluding the vessels engaged in purely local trade the arrivals and departures numbered 4,300, averaging 2,200 tons capacity, against 3,500 arrivals and clearances in 1892. Five hundred and forty-six cargoes of grain were shipped in the season, averaging 62,900 bushels. — *The Marine Record.*

It is recognized by foreign scientific publications that the United States not only makes most of the world's typewriting machines, but also most of the paper used thereon, especially that of high grade. Yankee manufacturers now compete successfully with those of England, France and Germany in what are to all of these countries foreign markets, but also in the British, French and German home markets. When it comes to fine papers, this particular success is due to the purer water often used, the better machinery and the Alexander like enterprise of the producer.

When it comes to paper for typewriters, of which there are a great variety, the essentials are a good finish and stock heavy enough to stand erasures without leaving a hole. Some of the best stationery intended for use with a pen is unsuited to the machine, by reason of its rough surface. The smoothness imparted to book paper by size and calendering is not, however, quite what is desired for typewritten documents. A "bond finish" gives about the right surface. This is secured by sandwiching smooth cardboards in with the sheets, applying a stiff cover, and then putting the stack under rollers weighing two or three tons. The labor involved in "plate pressure" is an important item in the cost of such paper."—*New York Tribune.*

One of the latest propositions of Mr. Edward Atkinson is to provide a special plant for fire protection in a business district of Boston, in which there are very high buildings closely packed together, the conditions being such that the risk of fire makes insurance rates ruinously high. He states that the insurable values in this district will amount to about $100,000,000, and that a system of stand-pipes, within the buildings, supplied with water by powerful steam pumps kept always in readiness for service. will, according to his estimates, cost about $500,000 or ½ per cent., and the decreased cost of insurance would make it pay handsomely. We believe in steam pumps as against high insurance rates.

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Exports of Machinery.

The most gratifying feature of the present situation with regard to machinery interests, perhaps, is the fact that our exports of machinery are constantly becoming more and more important. Those of our machinery builders who have paid even a small amount of attention to developing an export trade have in nearly every case been quite successful, and the better American machinery and tools become known abroad the better their reputation becomes. Especially is this the case with American machine and small tools, which have made for themselves a large and constantly increasing market in Great Britain, where the old-time prejudice against them is about gone and there is little trouble in selling them, especially where the grade of work to be done with them is of the highest character. In a number of continental countries this is so only in a lesser degree.

The same applies to American woodworking machinery, which is rapidly gaining an established place in England and other foreign countries, while in the newly developed mining enterprises in Africa our mining machinery has been extensively introduced in competition with English machinery, notwithstanding that British capital and British interests generally are paramount there.

Agricultural machinery and tools, too, have been making rapid headway in foreign countries, and some of our factories making harvesting machinery especially have found this foreign trade not only profitable, *per se*, but especially desirable to keep the wheels turning and men employed at times when the home trade alone could not do this.

The World's Fair has done very much to enlighten the most interested people of foreign countries as to what we are doing here, a very large proportion of the foreign visitors to the Exhibition being those who came here for the especial purpose of seeing what there was that might find a market at home.

It is gratifying to us also to know that the AMERICAN MACHINIST has taken a prominent part in the dissemination of that knowledge abroad that leads to and must precede an export business.

Our foreign subscription list has shown recently a very gratifying increase, and will be this year considerably larger than ever before. These foreign subscribers are almost without exception men who occupy positions of responsibility in British and Continental workshops, and who wish to be informed as to what is being done here.

They are, or will become, purchasers of American machinery and tools. It is, of course, true that there will be in foreign countries some copying of American ideas and machinery; this is inevitable, but the genuine will always have the preference, as experience has shown, and notwithstanding the copying, there will probably be a profitable market for us there for many years, and always, if we are continually mindful of the military maxim, which says, "Never despise your enemy."

Our exports of manufactured articles during the year ending June 30, 1893, amounted to over $830,000,000. Of this amount nearly $5,000,000 was received for agricultural machinery and implements, while in that class which includes manufactures of iron and steel generally, fire arms, builders' hardware, printing presses, saws and carpenters' tools, scales and balances, sewing machines, stationary engines, locomotives, etc., we exported nearly $30,000,000 worth.

We should undoubtedly have done better than this had it not been for the fact that in most foreign countries business was uncommonly dull during the specified period.

This increase of foreign business must be especially gratifying to those who have believed, as this journal has always maintained, that intelligent, skilled, ambition-inspired and high-priced labor is the cheapest labor, aside from its obvious advantages from a social standpoint.

Locomotive Tests by the A. S. M. E.

The Railway Review attempts in its issue of January 20th to defend its former attack upon the American Society of Mechanical Engineers for declining (as we think, wisely) to attempt to settle by an official test the relative efficiency of simple and compound locomotives. Our contemporary's defense of its position is so weak, and at the same time so completely answers itself, that we should not consider it worth while to reply were it not for the fact that we are accused of neglecting to read carefully the editorial we criticised, or, of wilfully misquoting it when we said that *The Railway Review* had charged the A. S. M. E. with acting in bad faith in the matter. *The Railway Review* now says: "What we did say was that this feeling existed among master mechanics. Our opinion is not expressed."

We confess that we did to this extent, and, strictly speaking, inadvertently misquote, but, at the same time, we feel very confident that this oversight of ours did no injustice to our contemporary, for much of its argument was founded upon the assumption that there had been bad faith in the matter, and it does not even now deny that its opinion is the same as that of the unnamed master mechanics.

And now, since we have been in a sense compelled to reopen this question, we may as well call attention to another matter. We quote again from *The Railway Review*: "In this reply [our reply] the statement is made that only a little over three per cent. of the members of the American Society of Mechanical Engineers are connected with railroads, which statement is advanced as an argument against the proposal that the society should give more attention to railroad subjects."

Now, as a matter of fact, our figures were given to show that the proportion of papers read before the society, that related directly to railroad subjects, somewhat exceeded the proportionate membership of railroad men, and that of these railroad papers about two thirds had been contributed by members not connected with railroads, and that therefore the master mechanics had no just cause of complaint, because the society was supposed to take so little interest in railroad matters.

The fact is that the interest taken by any society in any subject, or class of subjects, can be nothing more or less than the interest taken by its members in those subjects, and so long as the figures show that the percentage of railroad papers exceeds the percentage of railroad members, and, at the same time, that the percentage of papers on railroad subjects, presented by railroad men, is only about one-third the percentage of members connected with railroads, railroad men have no just cause of complaint.

As to the quibble about the refusal of the society to go into the tests not being the difficulty, but, instead, its reasons for declining to go into them, that amounts to nothing. It is well understood that the policy of the A. S. M. E. has been from the first, not to make official tests, or officially decide matters pertaining to mechanics or engineering, whether patented or unpatented devices were concerned, and that policy is undoubtedly the right one. The most the society could have done in any event would have been to pay out a considerable sum of money to defray the expenses of a test which, when made, would have become a matter of record in its transactions, and would have had to stand upon its own merits the same as any other record of a test, to be accepted as conclusive or not, as might seem best to those interested in such matters. Why should a considerable sum of money, say, $5,000, derived solely from dues of members, 97 per cent. of whom are not directly or specially interested in the matter, be spent in conducting a test that should be made by railroads and locomotive builders?

Our contemporary seems to think that about every other engineering problem can be very easily solved by a simple test and at small expense, but that when it comes to settling whether a simple or a compound locomotive is most efficient, that is such a much more difficult matter, and so much more expensive, that the railroad companies and locomotive builders can never hope to see it settled unless the master mechanics and mechanical engineers of the country, who, for the most part, have two places for every dollar they get hold of, go down into their pockets and defray the expense of settling it; which is nonsense from beginning to end. If railroad companies and locomotive builders want to know whether compound or simple locomotives are most efficient, let them pay engineers for making tests, and it will make no difference, so far as the interests of engineers are concerned, whether the men paid to do the work are the company's "own engineers," regularly employed, or outside engineers, employed for that special purpose.

In these remarks it should be understood that we give only our own opinions regarding the matter, that we are not in any sense authorized to speak for the society or any of its officers.

Benjamin H. Warder.

Benjamin H. Warder, of the Warder, Bushnell & Glessner Co., Springfield, Ohio, died in Alexandria, Egypt, January 13th, aged 70. For many years Mr. Warder was actively engaged in the management of large manufacturing interests, paying particular attention to financial matters, for which he possessed exceptional ability. He was highly cultured, dignified, rather reserved in manner, and though few persons knew him intimately, he commanded the highest respect of every one. To the city of Springfield he, some years ago, presented an elegant library building, donating land and building to the free use of its citizens.

We publish elsewhere in this issue an article by Mr. N. O. Nelson, of St. Louis, whose profit-sharing plans and their results we have previously referred to, and who has studied these matters from the manufacturer's standpoint—a manufacturer who, as his article indicates, derives satisfaction from the knowledge that he has at all times the hearty co-operation and good-will of his employes, and is willing to go to some trouble to secure it. Mr. Nelson writes largely from his own experience in carrying on extensive manufacturing operations, and his article is therefore as practical as that of a shopman writing of a shop process with which he is familiar.

Second Monthly Meeting of Engineers.

The second of the monthly meetings of engineers, for discussion, will be held at the society's rooms, 12 West Thirty-first street, on Wednesday evening, February 14th. The subject will be the same as at the last meeting, viz., "The Development of Stationary Engines as Illustrated by those Exhibited at the Columbian Exhibition." It is expected that Prof. John E. Sweet will introduce the subject. Members are privileged to invite their friends to be present, and to engage in the discussion.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(61) G. C. M., Indianapolis, Ind., writes: Please inform me whether the U. S. Patent Office publishes regular reports: If so, where and how can I obtain copies? *A.*—The Commissioner of Patents issues every week the *Official Gazette* of the United States Patent Office, containing patents, trade marks, designs and labels issued during the week; price per copy 10 cents. You can obtain these by writing to the Commissioner of Patents, Washington, D. C.

(62) W. A. M., Canobie Lake, N. H., asks: Can you inform me if there is an underground trolley system patented? If so, who is the patentee? If you cannot give me his name, please inform me where I can get a list of patents issued in the last five years? *A.*—There are several underground trolley systems patented. We believe you will be able to get record of patents granted during the last five years by writing to the Commissioner of Patents, Washington, D. C., or any good patent lawyer will search the records for you at a comparatively small cost.

(63) A. J. C., Willsborough, N. Y., writes: Please inform me if there is a pump made which, with a pressure of 45 pounds of steam taken from one boiler, will force the water into another boiler carrying a pressure of 100 pounds. If so, what kind and make should I get? *A.*—All manufacturers of pumps, or any dealer in pumps, can furnish you with a pump for the work you specify. The kind of pump is a matter of personal preference, and you must make your own selection, as we will not recommend any kind of machinery in preference to others.

(64) E. L. T., Manset, Me., writes: Please inform me through your columns where some of the schools of technology are located, and how much it will cost per year to attend one? *A.*—The nearest technical institutions to your residence are, the Massachusetts Institute of Technology, Boston, Mass.; Stevens Institute, Hoboken, N. J.; Lehigh University, Bethlehem, Pa.; and Worcester Polytechnic Institute, Worcester, Mass. Write to any of these for a catalogue and cost incurred in taking a course of instruction. 2. Will it require a shorter time to graduate if the student had shop experience before entering a school? *A.*—We believe not.

(65) W. H. V., ——, asks: Will you advise me as to what is the best material with which to daily wipe the bright parts of machine tools to prevent rusting and discoloration? *A.*—Discoloration of bright parts often results from the use of a lubricating oil which either contains some acid that discolors, or, by evaporation, leaves upon the surface a brown or yellow coating. Avoid such oils. A good plan is to take pains to keep the bright parts somewhat oily, where the use of the machine does not have this effect, and, if necessary, rub them occasionally with vaseline, which can be applied by a piece of waste. It is usually difficult, however, to entirely prevent discoloration, and there must usually be some scouring with emery cloth if its entire prevention is important.

(66) A. A. A., Chicago, Ill., writes: Please give me the comparative tensile strength of bars 1x¼ inch of wrought-iron, Bessemer steel of low carbon, and ordinary malleable iron. I am unable to find any recent reports on malleable iron in any of my mechanical works? *A.*—The ultimate strength of wrought-iron bars varies from 44,000 to 62,000 pounds per square inch; Bessemer steel from 70,000 to 74,000 pounds per square inch. Malleable iron is a treacherous material when subjected to a tensile stress, and should not be used for that purpose; its tensile strength may vary from 30,000 to 50,000 pounds per square inch, in fact, the tensile strength may be much less than the lowest value as given above. On account of the wide range of strength of different qualities of the same material, tests should be made of all materials that enter into any kind of structure of importance, and the loads limited accordingly. In the above we have given the tensile strength per square inch, the area of the bar of the given dimensions is only ¼ square inch, hence the ultimate strength of this bar will be only ¼ of the strength given.

(67) J. D., New York, asks: Will you please inform me of a rule making fits to "swear by"? For instance, in making a force fit, say, of a 6″ shaft to press on, at eighty tons, or to fit a piston to a cylinder 40″ diameter, or to make neat running fits. Is there any book published on this subject? *A.*—The ability to make such fits with certainty is one of the things that a machinist acquires, if at all, by practice. The novice who must attempt it had better first make his fit surely tight enough and then try it, reducing the size until the fit is right. Careful calipering of the hole and shaft will then show what the fit must be in similar cases. In learning to make such fits, the best plan is, however, to get an experienced man, if possible, to do the calipering and then before the work is put together let the learner carefully caliper hole and shaft in his own way and with his own calipers. It is, however, getting to be common to use large inside micrometer calipers, such as we have illustrated in our columns, for this work, and when this is done the needed allowance for various cases can soon be made a matter of record in decimals of an inch.

(68) C. H., Decatur, Ill., writes: As I have had considerable trouble in pasting my blue prints on cardboard I would thank you to answer the following questions: 1. What kind of cardboard is most generally used for pasting blue print paper on for shop use? *A.*—We are not aware that any particular kind of cardboard is generally used for this purpose. If several machines are to be built from the same set of blue prints it pays to get the best quality of cardboard; if only one machine is to be built from the blue prints, and if it is not deemed necessary to keep them for future use, we should use the cheaper kind of cardboard. As far as pasting is concerned it does not make much difference which kind is used. 2. What is the best kind of paste to use and how can it be made? *A.*—We should use gum arabic dissolved in water to a suitable consistency. 3. I have had trouble with the cardboard warping and the blue prints wrinkling after the blue print has been pasted on the cardboard. How can I remedy this? *A.*—To prevent warping we should place a weight on the cardboard while it is drying. The wrinkles can be avoided only by the proper manipulation of the paper in pasting it to the cardboard, and this is best obtained by practice.

(69) E. E. R., Milton, Pa., writes: Please give me a receipt for putting a polish on brass, something that will not deaden the bright finish left from the polishing lathe? *A.*—There are several ways of cleaning and polishing brass. Good results are obtained with sweet oil and tripoli, powdered bath brick, rotten stone or red brick dust rubbed on with flannel and polished with leather. Vitriol and muriatic acid make brass and copper very bright, but they very soon tarnish and consequently require more frequent cleaning. A strong lye of rochealum water will also improve brass. A solution of oxalic acid rubbed over tarnished brass with a cotton rag soon removes the tarnish rendering the metal bright. The acid must be washed off with water and the brass rubbed with whitening in powder and soft leather. When acids are employed for removing the oxide from brass, the metal must be thoroughly washed afterwards, or it will tarnish in a few minutes after being exposed to the air. Sometimes the following is used: Soft soap, 2 ounces; rotten stone, 4 ounces; beat them to a paste. Or, rotten stone made into a paste with sweet oil. Or, rotten stone, 4 ounces; oxalic acid, 1 ounce; sweet oil, 1½ ounces; turpentine enough to make a paste. The first and last are best applied with a little water. The second with a little spirits of turpentine or sweet oil. All require friction with soft leather. The Government method used at all the United States arsenals is claimed to be the best. The articles to be treated are dipped into a mixture of one part of common nitric acid and one-half part of sulphuric acid kept in a stone jar. After this the articles are immersed in water which should be kept close at hand, and finally rubbed in sawdust. If the brass has become greasy it is first dipped in a strong solution of potash and soda in warm water.

(70) J. R., Cambridgeport, Mass., writes: I have made eight steel upright boilers as per sketch. They are used for power in unloading coal from vessels; they are in towers 40 feet above the wharf; they are not covered, and are exposed the most of the time to a cold draught of air through front and back doors in the towers. The boilers are made in first-class shape; good fair holes and tight fits, wrought-iron rings and door frames, both being drilled when in place through furnace shell; tested to 160 pounds cold water pressure, and made perfectly tight. Now, the boilers have started to leak at the bottom of the ring, where it is calked to the furnace shell, and also inside of door frames, cracks running from rivet holes in door frame to the calking edge. I claim that the leaks are caused at the bottom of the ring by unequal expansion, 8 inches of furnace shell being exposed to the cold air, while the other 30 inches in height of the furnace are subjected to the intense heat of the fire, and the cracks and leaks on the inside of the door are caused by the plate not being protected by water where it is riveted to the door frame. Am I right or wrong? *A.*—You are right. In this boiler the furnace shell extends 8 inches below the furnace ring, not surrounded by water, but exposed to cold currents of air. Above the furnace ring the same shell is exposed to an intense heat; of course, this part of it, as well as the outer shell, will expand, but the bottom of furnace shell remains cold, and does not expand, or, if it does, it will be but a small amount; now the outer shell expanding to a greater extent will tend to draw the furnace ring away from the furnace sheet, and cause leakage at the place where it did occur. Cracks around the door sheet are due to some extent to this particular construction of boiler, and to some extent to the quality of the material used, and although there are many boilers made in this way, and have been in successful use for years, we are never surprised to find that some will crack as stated. In our opinion, the best way of forming the fire door opening is to flange the outer and inner shell outwards, and rivet these together on the outside of boiler.

(71) Speed, Munhall, Pa, writes: It would be of service to me, in some work I have in hand, if you will kindly reply to the following: What should be the size of an air pump for a compound surface condensing launch engine; high pressure cylinder 4 inches diameter, low pressure cylinder 7 inches diameter; stroke 5 inches? The boiler pressure is 100 pounds, revolutions 500 per minute. The engine is designed to cut off in full gear at three quarter stroke. I would be pleased to have the formula for ascertaining the above, so that I could apply it, if I desire to design a more powerful engine. *A.*—The quantity of water to be removed by the air pump, whether for a jet or surface condenser, can be easily determined, but the quantity of air which the pump has to remove is a variable quantity and cannot be computed. It is therefore necessary, especially in the case of surface condensing engine, to rely more on experience than on calculations. The most convenient formula is probably the following taken from Seaton & Rounthwaite's "Marine Engineering Pocket book": Divide the indicated horse-power of the engine by the number of revolutions per minute and multiply this product by 300 for a single-acting vertical pump and surface condenser, and 700 instead of 300 for single-acting vertical pump and jet condenser. The result will be the capacity of the pump in cubic inches. In our opinion the air pump should be driven independently, as the number of revolutions of the engine (500) is too great for the air pump. We should prefer not to run the air pump at a greater rate than 200 down strokes per minute. Your engine under favorable circumstances may develop 27 indicated horse-power, and for a speed of 200 down strokes of the pump the capacity of the pump will have to be

$$\frac{27}{200} \times 300 = 40\tfrac{1}{2} \text{ cubic inches}$$

A pump 4¼ inches in diameter and 3 inches stroke will have this capacity, and we believe these to be good dimensions of the air pump for your engine. 2. Can you recommend a book that treats on the subject of the design of fast launches and their engines? *A.*—We have not seen a work that treats on launches and their engines that we care to recommend; but it seems to us that A. E. Seaton's "Manual of Marine Engineering," an excellent work and recognized as authority, should be of aid to you. Although the author does not treat on launch engines in particular the rules given can, with only a slight modification in some cases, be applied to the design of these engines.

(72) A. J. D., St. Louis, Mo., writes: The following rule for proportioning the ports of slide valve engines (plain slide valves) appeared in the AMERICAN MACHINIST a few years ago: Multiply the area of the piston in square inches by its speed in feet per minute, and divide the product by 8,000 for the area of the steam ports, and 6,000 for the area of the exhaust port. In another paper a correspondent asks for the dimensions of the ports in an engine having a cylinder 6 inches diameter and 10½ inches stroke, and making 120 revolutions per minute. He was told to make the steam ports ⅛x5 inches, and the exhaust ports 1x5 inches. The areas of these ports calculated by the above rule will be .742 square inch for the steam ports, and .99 square inch for the exhaust port. Now these areas are evidently entirely too small. I suppose the rule will apply in some cases, but not in all. Please explain this? *A.*—There are engineers who use the above rule; it is based on the theory that for a piston speed of 800 feet per minute the steam port area should be $\frac{1}{10}$ of the area of the piston. This rule gives good results in some cases, particularly in those in which the steam ports are not used for exhausting, as is the case in ordinary slide valve engines. In the latter class of engines we prefer to make the area of the steam port $\frac{1}{10}$ the area of the piston for a piston speed of 600 feet per minute. This will give an area of steam port equal to that of the exhaust port as found by the rule you have quoted. There are manufacturers of stationary engines who prefer to make still larger steam ports, and find the area on the basis that for a piston speed of 500 feet per minute the area of the steam port should be equal to $\frac{1}{10}$ the area of the piston, and for other speeds in proportion. Marine and locomotive engineers generally make the steam port area equal to $\frac{1}{10}$ of the area of the piston for a piston speed of 600 feet per minute, and this rule we always use in answering our correspondents. It may be expressed as follows:

$$\frac{a \times s}{6{,}000} = p.$$

in which a = area in square inches of the piston; s = piston speed in feet per minute, and p = steam port area in square inches. But this involves finding the area of the piston, which frequently takes too much time. For practical use the formula can be reduced as follows: Remembering that the area of a piston is equal to the square of the diameter multiplied by 7854, we may write the foregoing in the following form: Let d = diameter of piston, we then have

$$\frac{d^2 \times .7854 \times s}{6{,}000} = p,$$

which reduces to

$$\frac{d^2 \times s}{7{,}639} = p,$$

which is a better form for practical use. Applying this formula to the size of engine referred to, we have

$$\frac{6^2 \times 210}{7{,}639} = .98 \text{ square inch},$$

which does not differ so very much from your answer. This area is large enough for a speed of 120 revolutions per minute. But engines of the given size frequently run up to 300 revolutions per minute, and the dimensions of steam port we have given are suitable for this speed, as will be seen by applying the formula. When the lap of the valve and width of bridges are not known, we make the width of the exhaust ports twice the width of the steam port, which in nearly all cases will prevent a too great contraction of the exhaust ports, when the valve is at the end of the stroke. When the lap and width of bridges is known, the better way will be to find the width of exhaust port by the graphical construction explained in our issue of May 1, 1890; this will reduce the length of the valve to a minimum under the conditions named in the article.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila., Pa. See p. 12.

Forming Lathes Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

Chucks, the Nat'l, est'd 1882. 39 Cortlandt St., N. Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Seiden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Steam Pressure Regulators, Reducing Valves, Safety Checks. Foster Engineer'g Co., Newark, N. J.

Upright Drills, stationary head, W. & L., with or without B. G. J. E. Snyder, Worcester, Mass.

M. E. Howard, Indianapolis, Ind. Specialty, 4 and 8 H. P. engines in stock, write for price.

The American Packing Ring will make your pistons steam tight. It is simple, durable and inexpensive. J. H. Dunbar, Youngstown, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp, 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton Avenue, Philadelphia, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Through Profit-sharing to Co-operation.

Profit-sharing, as understood in this country and in France, is a division of the profits of business between proprietors and their employes. The usual method is to pay ordinary interest on capital, and then divide in some previously fixed ratio between capital and the wages fund. There is no established formula governing the ratio. The purpose of the projector, the profitableness of the business, and the proportion of capital to wages and to profit, are factors that enter into the calculations in each case. Sometimes the management takes a certain part of the profits for services and reward for ability, and the remainder is divided between capital and wages or between interest

and wages. The latter is the plan of the well-known Godin House in Guise, France. Sometimes the division is by equal percentage on capital and wages, sometimes two per cent. on wages for one on capital, sometimes a fixed fraction of the profits is given to wages, and in others a portion of the excess above the ordinary profits. The motive of some proprietors is to make more money for themselves by stimulating the self-interest of employes. In others it is to make a better division of the earnings of the business. In most instances, some part is assigned to a provident or mutual benefit fund, and something for a reserve fund.

Any proprietor or corporation which has a profit-earning business can adopt this system. It matters not what be the character of the business. There is no need of any change in the organization or the management. There need not be any other action taken than the bare announcement that the stipulated division will be made at the end of the year. The announcement should never be coupled with any conditions or made the subject of a contract. Any attempt to make it the excuse for harder terms or a restraint upon liberty will defeat its purpose. Any well-disposed employer may safely set it in motion in the simplest manner, and leave the results to the universal instinct of self-interest and the not entirely rare disposition to reciprocate good-will. He will be surer of doing a safe business, he will have less waste of time and material, he will need less watchfulness and anxiety; but, if he gives to wages such an extra sum as will be a substantial inducement, then he cannot expect that his own profit will be actually increased. If he takes some interest and pleasure in seeing all those about him doing better for being under his direction, if thorough organization and harmonious working are matters of pride and satisfaction, if he cares more for a safe and permanent business than for sudden but precarious gains, profit-sharing will amply meet his expectations. The effect of such a system will be to modify the hard and grinding attitude so common in large industrial bodies. The habitual fighting relation will give way to a tolerably well-defined sense of mutual interest, not unlikely to merge into a genuine feeling of fellowship. When besides the customary wages there is a further contingent sum, and provision for sickness, old age, and death, the strictly commodity aspect of work and workmen is sure to take on a little of the coloring of human relationship, a little of the club or social spirit. From either the political or the moral standpoint, this closer relationship cannot be a matter of indifference. Certainly, the hired man, of whatever degree, will gain something by contact with the men of broader experience, when he meets them in annual or special meetings. The opportunity should always be given employes to invest their dividends and savings in the capital of the company, and this possession of income-earning shares gives a new sense of responsibility and independence.

The employer will be greatly the gainer by a closer acquaintance with his working associates and subordinates. Even the employer who sincerely desires to be the friend and associate of his men has not the opportunity. His work and his interests are apart from theirs. He has no necessity to know their names, much less their faces or their fortunes. The fear is entertained by some that profit-sharing employes will desire to interfere with the management or will resent authority. But these critics overlook the fact that the corporate organization and authority remains undisturbed. They forget that a stockholder cannot interfere with the regularly elected officers; and they forget, also, that no one is more interested than the employe in having the business well conducted from which his dividends as well as his wages are to come.

A still more common objection is raised in the question whether employes will make good losses as well as share profits. Certainly, they will, when so required in a reasonable manner. There should always be a reserve fund created by holding back a part of the profits before dividend is paid. This fund the employes have helped to create. Losses are met by it, and the employes have thus borne their part. It may also be fairly inferred that the losses will be less, owing to the employes' better efforts. But a direct and practical answer to this question is found in the case of a profit-sharing corporation in a neighboring city, which employs about five hundred men. For two months the force has been working full time on three-fourths pay, for the double purpose of husbanding resources and joining in the loss of this unfavorable year, should there be any. The amount deducted is to be made up out of future profits. This arrangement was not only acquiesced in, but was cordially approved.* Workmen may be depended upon to use good sense, when given fair consideration. There is no class any clearer-headed or fairer-minded, when properly treated.

The United States have a considerable number of profit-sharing concerns, but there is no appreach to uniformity of plan. The French are far ahead of us in theory and organization and practice. Yet, while France and this country have done and are doing a good deal through this system toward the amelioration of the iron law of wages, we must not indulge in too great expectations from a system the growth of which depends upon the initiative of proprietors whose whole business education has been in the school of personal profit-making. We cannot count on a disposition on the part of proprietors in general to divide profits with a force of men who seem to them fully settled with when the contract price is paid. Most employers have risen from the common level. They have gained ascendancy by energy, shrewdness, and hard knocks. They are a natural selection of the fittest—for making money. The moral sentiments, or broad philosophical considerations, are not their dominating motives. They have not been educated in a school of ethics. The majority of them are honorable men, judged by the commercial code. But the commercial code commands them to buy cheap and sell dear, to make profits, to build up a large and prosperous business, and to raise a substantial fortune. Having these motives always with them and these prizes always tempting them, it will be the exceptions only that will choose to divide either authority, responsibility, or profits with men for whose services they pay the market price, and from whom they exact a day's work and no more.

There is in profit-sharing the germ and suggestion of a stronger and more universal system—a system which carries within itself the power of expansion, and which embodies a principle of universal application; namely, "co operation." What profit-sharing has in it to stimulate work, co-operation has in a much higher degree. In this system not a part, but the whole, of the profit, accrues to those who produce it, whether as workers or customers. In co-operative factories the capital is owned by the workers, and draws simple interest, while the profit is divided upon wages. Whatever the business yields the worker gets in proportion to his part in the joint production, as represented by his wages. The manager is elected in the same way as managers of other corporations, and has the same authority, with such pay as will secure competent men. The workers receive the wages that are customary in their trade and locality. If the business be well managed and the workers industrious, there is nothing to stand in the way of success. But, because a factory takes capital and business experience, and workmen, as a rule, have neither, it has proved to be exceedingly difficult, though not at all impossible, to start co-operative manufacturing enterprises, and carry them through to success. When times are good, and all the best men have steady work at good pay, there is but little charm in going into new and untried ventures. The field of business enterprise is notoriously full of wrecks. The plain workingman is not a speculator. His disposition is toward plodding, and his education is in routine and dependence on a master. He is used to a cash in-hand quick return for his week's labor, without which he doesn't see a living. He has only a curious sense of the magnitude of commercial figures, and not much faith in the returns which come after months or years. If he be of a frugal and forecasting turn his savings go into the bank, where the interest is added to the principal semi annually, and where he can, or thinks he can, put his hands on the whole sum when he wants it. When the freezing times of business depression overtake the workingman he is wholly unprepared either to provide the capital for a factory or to get business. He is in much the same predicament as the Arkansas man, whose leaky roof didn't need mending in fair weather, and couldn't be mended when it rained. The incipient co operative factory association offers him no temptation.

The working class, having no adequate opportunity of their own, or recognized claims upon leadership, confront the problem of industrial independence with every element of weakness. In this country and in Europe many co-operative factories in the aggregate have been started, usually as the outcome of strikes; but the successes are so rare and are the result of so exceptional circumstances that they count for little in transforming the prevailing system of private enterprise into a co-operative system. The cooper shops of Minneapolis, the furniture and shoe factories of Rockford, the planing-mills of St. Louis, and creameries in all quarters, abundantly prove that co-operative management is as safe and co-operative profits as large as under private ownership, when the initial difficulties are once overcome. Nothing, in fact, could be clearer than that men will work more efficiently under the incentive of a possible 10 per cent., 25 per cent.,'or 50 per cent., addition to wages at the end of the year. The plan joins all the allurements of a prize to the substantial incentive of acquiring property and securing better living.

While co-opetative factories are difficult to start, *co-operative stores* are easy; and out of stores factories may easily develop. It takes but the slightest bit of good sense, a very little money, and a grain of public spirit to set up a co operative store. Because it takes only a little of these qualities, which in our times are not rare, co-operation, as a substitute for competition, is making firm and constantly accelerated progress. The growth of co operative distribution in the last fifty, but especially in the last twenty-five, years, would seem fabulous and romantic, were it not for the intensely practical aspect of dollar and pound sterling figures. Co-operative stores that have run a half century, and have accumulated property counting into millions, single corporations whose annual sales reach near to fifty millions, a uniformly increasing membership, capital and sales—all these point to a movement which represents the very spirit of the age.

These stores, which are now a leading factor in the commerce of Great Britain, and which are much more numerous and prosperous in the United States than is generally known, have a wider purpose and influence than the saving of middlemen's profits. Education, honesty and sound economic practices are their guiding principles. Co-operation disowns the epigram, "Competition is the life of trade," and takes exception to the doctrine that the higgling of the market will give every one his just share. Theoretically, competition will level prices to the slightest advance above cost and expenses. In practice, the almost universal ignorance of the consumer as to quality and price of each of the multitude of articles which he must buy, leaves him a prey to the caprice of the ever alert private dealer. It would surprise many of us to learn how many articles we buy at two or three times the manufacturer's cost. I have been strongly inclined to compile a statistical history of a dozen items of common use, following them from the natural raw material to the finished article in the final consumer's hand, tabulating the items of necessary work upon them and the service of transporting and delivering them, showing the waste time, the profits at various stages, and the price finally paid by the consumer. I can say advisedly that very many of the products of factory and farm cost the consumer several times the value of all the necessary services performed from start to finish. This is not alone or chiefly because of the profits that are realized by the various dealers through whose hands the product passes, but because of their waste, their half-used room and help, and their various extravagant efforts to get trade. Then, there are the processes of adulteration, with their useless outlay and deleterious ingredients. There are butter factories that never knew the odor of cream or milk, factories making cigar stumps and abandoned tobacco chews into cigarettes and cheap cigars, and distilleries turning last year's Illinois corn into ten-year-old Kentucky whiskey. We have it on the authority of the Governor of South Carolina that, of all the samples of liquor brought in by the State inspectors, scarcely one was pure; nearly all were chemical compounds. Our haberdasher tempts us with showy but fading colors; our draper, with woolens that are two parts cotton and one part shoddy. We are not only drawn into buying what we do not want, but we are ever shopping with the uneasy feeling of a hungry chicken which picks up the crumbs at your feet in mortal fear that you have some hidden design in your show of kindness.

Private profit is inevitably and everywhere a temptation to delude the buyer's judgment and the seller's conscience. It teaches men to study more the selling qualities than the wearing qualities, to humor the follies of mankind rather than its needs. One fruit of this motive is that our shops, our art stores, even our homes, are bedizened with the gewgaws and tinsel which turn them into what Howells' Mr. March calls "James-crackeries." In a co-operative store there is no tendency of this nature, because there is no private profit. The members have no motive in cheating or deceiving or poisoning themselves. It is the manager's business to see that they get pure goods, full length, and durable quality. There is nothing to lead the store clerk to misrepresent or persuade. The managers and help are there for the sole purpose of laying in the supplies that are wanted, and dealing them out to those who want them. As every member is an owner, it is unnecessary to occupy a prominent and expensive corner or incur extravagant expenses. Where competition sets up half-a dozen stores and shops in the same vicinity, duplicating each other, one co-operative store does the same service and saves the five parts of expense.

In describing a store of which I am a member, I shall outline the plan on which nearly all the successful ones have been started and now conduct their business. Nine persons, eight of whom were workmen, agreed to join in starting a store. Each took one share of $50, payable at fifty cents a week or more. Some of the members paid their shares in full. There was thus enough money to buy a small assortment of groceries, which were put into an unoccupied room, and one of the members volunteered to be storekeeper and do the work after business hours without pay. At the end of two months the membership had increased. Account of stock was taken, and a clear profit of 15 per cent. on the sales was found to have been made. This was paid to the housekeepers in proportion, not to the capital invested, but the goods bought. Articles of incorporation were then taken out under the State Co-operative Statute, which very judiciously provides that each member has one vote and no more, that no dividend exceeding the legal rate of interest can be paid on shares, and that all other profit must belong to the members. Under this law rules were adopted and registered, among them being the one most essential to co operative success—that all

* Full pay was resumed October 1st.

buying and selling shall be for cash. Under this rule the association cannot buy anything unless it has the money ready to pay for it; nor can any member, no matter how amply responsible or what the circumstances may be, buy anything without paying for it on the spot. Herein lies one of the greatest reforms of co-operation. It destroys credit, or credit will destroy it; hence all successful co-operative stores are educating their members into frugality and independence. Credit is the monumental evil of all times, enslaving in invisible chains the unhappy victims of its seductive advances. No greater blessing could fall upon a set of people than to get entirely broken away from buying on credit. The legislation that is needed, if any, in behalf of the debtor class, is the repeal of collection laws as to all future debts. There would be no panics if there were no overloading of debts, and there will be overloading as long as the laws support the system. While the temptation is great in the store to waive the rule for the convenience of members who do not like to trust money with the children, or who can pay Saturday, or who are temporarily in straits, it is never safe to vary a hair's breadth from the rule. Forethought is a thing it is well to learn, and, if a person is in need of assistance, he should apply to personal friends instead of the store.

This store to which I belong has grown steadily in members, in capital, and in trade. It takes account of stock every quarter; and, after the storekeeper's account is audited, interest at 6 per cent. is paid on each member's paid up stock, and usually a 10 per cent. dividend on his purchases. The actual net earnings have averaged 15 per cent., but a portion is credited to surplus. The affairs are conducted by actual workingmen, there being but two members whose daily occupation is not manual labor; and neither of these is an officer or concerned in the active management. The payments of 50 cents a week have been entirely regular—an easy enough matter, when in most cases the dividends will equal the payments on shares. The stock has kept increasing, and there is a surplus of cash on hand. Quite a number have joined who are not housekeepers, but regard it as a convenient savings investment. Nothing could well be safer if the essential principles of co-operation be observed—cash dealings and attention. There is bound to be a profit, and there is no reasonable way of making any loss. The quarterly stock-taking checks any actual thieving by the storekeeper; a simple check system insures against fraud; cash is regularly turned over to a bonded treasurer, and goods are too bulky to be run away with. So long as the managing committee or board of directors perform their duties with even tolerable faithfulness, there can be no loss in a co operative store.

I have outlined this simple and successful store, instead of the old and large ones, because I wish to convey the facts of my own experience. I want to impress on you the simplicity and ease and certainty with which any set of people, rich or poor, few or many, may have a store of their own, be their own purveyors, save their money, be free from exposure to tricks of trade, and accumulate funds for use in productive enterprises. This store of ours is patterned entirely after the magnificent examples which abound in every part of England and Scotland. Those splendid specimens of business built up by working men are a marked contrast to the small shops and crude methods of private trade. The English Wholesale, with sales of nearly 50 millions a year, does its enormous business at a cost of a fraction under 2 per cent. Who of us does it for three times that rate? They buy from first hands in nearly every leading country and market, sail their own ships, and do their own banking and insurance for the co operators. The Equitable Retail Store of Rochdale has 12,000 members, and a capital of almost 2 millions of dollars. The sales in 1892 were 1¼ millions, and the profits $175,000. Two societies in Oldham have together nearly 22,000 members, 1¼ millions capital, 3¼ millions sales, and ¼ million net profits. The Leeds Store has 30,000 members, 2 millions of capital, $4,300,000 sales, $545,000 net profits; and the business was done at a cost of not quite 4½ per cent. There are many similar large societies, and others in all stages of growth. Of those reporting to the federated board, there are 1,655 societies, many of which have branches, with 1,240,000 members, over 75 millions of capital, and annual sales of over 250 millions, which are handled at an average expense of 5½ per cent., and yield an annual clear profit of 24 millions. The large capital accumulated is the surplus left over after paying 5 per cent. interest on shares, and dividends on purchases ranging from 8 to 15 per cent., or an average of at least 10 per cent. Most of the societies provide an educational fund. Some of them have splendid libraries, and they are liberal contributors to funds for public purposes. But they do not stop at honest and economical trade and education and public spirit.

CO-OPERATIVE FACTORIES.

The money that is so easily accumulated in the great stores is turned into manufacturing capital. They have the money and the business experience, and the demand is already in their hands—the most perfect possible combination of advantages for manufacturing. There are in Great Britain nearly 200 regular co operative factories, most of them belonging to the stores. These have a combined capital of 8 million dollars, of which 3½ millions are in lands, buildings, and machinery. They turned out last year a product of over 18 millions, at a net profit of $825,000.

A number of these factories are the largest and best equipped of their kind in the world. They have abundant capital, a uniform and unfailing demand, and are in charge of managing ability of the first order.

France is ahead of America in profit-sharing, and Great Britain in co-operation; but we have at least got started in the right way, and we have reason to expect a steady development along the genuine Rochdale lines. Great numbers of Grange and Alliance and Union Stores have been started during the last twenty years; but, unfortunately, the greater part of them were projected on a large scale by inexperienced men, and with the credit system as one of the chief attractions. They lacked every element of success. It is so hard to learn the difficulty and uncertainty of getting something for nothing. Credit will ruin any co-operative attempt, and is tolerably sure to ruin any business. A new occupation must be learned in the a b c fashion, whether it be editing a newspaper, running a hotel, or keeping a store. Expenses must bear such a relation to the business done that, in spite of initial blunders, there shall be a substantial dividend from the very beginning. There must be no such thing as starting off with a full complement of expenses, and trusting that the trade will come to cover them, and a proper dividend besides. For this reason the ardent member's unoccupied room, a volunteer storekeeper, and each member carrying home his own goods, is the orthodox plan for starting a store, and about the only safe one. Such a start insures determination, personal interest, and dividends. The thousands of members and millions of business which come in time are all the more real as well as romantic upon such a foundation. Most of the unsuccessful stores have started to sell at cost plus expenses, aiming to come out just even. This accumulates no capital, neither does it have any dividends to show the tangible results of co-operation. But experimental failures never destroy a principle. The experience has been hard, but useful.

For lack of any central organization in this country, we hear but little of the considerable number of very successful stores which are doing business on correct co-operative principles. The Arlington at Lawrence, Mass., is about eight years old, has 1,800 members, and sales of a quarter of a million a year. Its dividends average 7½ per cent. on purchases. There are large stores at Brattleboro, Vt.; Trenton, N. J.; Lyons, Ia.; Olathe, Kan.; and Galveston, Tex. Some hundreds are scattered over the country. No union or federation has ever been attempted, and it is impossible to ascertain the location and condition of all the stores. In England there is a Co-operative Union with a central board and paid general secretary, quarterly district conferences, annual congresses, and a magnificent spirit of propagandism. The movement in this country is ripe for organization, and, when this is once effected, the spread will be rapid. Co operative economy and co operative energy will supplant wasteful and demoralizing competition, just as large and well-organized corporations have supplanted the small shops. Union for common good is as commendable as combination for individual greed is reprehensible. Equality of opportunity will give approximate equality of conditions; and we may hope that genuine co-operation will lead us out of the nervous scramble of competitive business into a reasonable system of mutual service. N. O. NELSON—in *Employer and Employed.*

The Fire at Purdue University.

Supplementing our brief notice of last week, we publish now some further particulars regarding the destruction by fire of the Engineering Building and Mechanical Laboratories of Purdue University, Lafayette, Ind. It will be remembered that our friends and contributors, Profs. J. J. Flather and W. F. Goss, are at that institution—Professor of Mechanical Engineering and Professor of Experimental Engineering, respectively. The further information here published is from friends in the University, and is as follows:

"The new Engineering Building and Mechanical Laboratories of Purdue University, Lafayette, Ind., which were dedicated with imposing ceremonies January 19th, were destroyed by fire January 22d, within less than a week after their dedication, and before the class rooms in the main building had been occupied for recitations.

"The new buildings and equipment represented a value of $180,000, on which there was an insurance of $45,500. The loss is probably $150,000. The Experimental Laboratory formed the nucleus of these buildings, and was erected three years ago. The equipment of this department was very complete; besides the experimental locomotive, there were a 100 horse-power Harris-Corliss triple expansion engine of special design, a compound Westinghouse engine, two Atlas engines, a Pyle rotary engine, two types of gas engine, a 100,000 pound testing machine, a cement tester, various steam pumps and apparatus for testing gauges and indicators, calorimeters, condensers, turbines and water-wheels, various forms of dynamometers, a 45 foot standpipe for hydraulic work, and various miscellaneous apparatus usually provided in testing laboratories. There were also in a room adjoining a 100 horse-power Babcock & Wilcox boiler, and a horizontal tubular boiler of similar capacity. It was in this department that the greatest loss occurred.

"In the machine shop, a large room 48x85 feet, the loss was also very great. In this room were twenty-four engine lathes of various sizes, six speed lathes, a 30" planer, a 22" planer, three drill presses, a Brown & Sharpe universal milling machine, a B. & S. universal grinder, two tool grinders, and various small tools, and a fine equipment of taps, reamers, gauges, and other special tools. The shops and experimental laboratory will be rebuilt at once, but it will take years to replace the equipment which has been accumulating since the birth of the University. The erection of the main building containing the drawing and recitation-rooms will probably have to be deferred for the present, as there are no available funds for this purpose.

"The buildings which have been destroyed had been in contemplation for several years, and an attempt was made three years ago to obtain money from the State for their erection. The Legislature, however, appropriated but $12,000 for the purpose at that time. Although inadequate for the demands, this money was put into a building which constituted the Experimental Laboratory which has just been destroyed.

"Amos Haevilon, inspired by the growing needs of the institution, contributed $35,000—half his entire fortune—to the furtherance of the enterprise. This, with $35,000 appropriated by the last Legislature, together with federal aid and private donations, made completion of the original plan possible, and the Engineering Building with its fine equipment was the result."

It is thought the fire may have started from a leak of natural gas, which was used under the boilers, two more or less violent explosions having immediately preceded the appearance of the flames, according to the report of a local paper.

Subscriptions began to come in for rebuilding the morning after the fire, and it is hoped that it will be possible soon to replace the building.

We are informed that all the valuable papers and records of tests with experimental locomotives were lost.

England's Marine.

BY J. C. MONAGHAN.

Patriotic Englishmen are alarmed about their ships. Neither in number nor technical perfection, it is claimed, do they equal what was believed of them. If cruisers are wanted they are not cruisers, their plating is far from perfect, their armament is deficient. In a storm last week the "Resolution" rolled so that old sailors were waiting and watching to see her go down into Davy Jones' locker. Long ago, Lechner, the German marine technician, demonstrated that England's ships, especially her new ones, would never come up to expectations. At the same time he claimed for German ships ability to stand tests severer than those made in England. The 450,000,000 marks paid by England for 70 men-of-war has not been a most profitable investment. It is claimed that in no part or point of construction do they answer demands. German ships built for 15 knots and 8,000 horse-power were turned out at 9,500 horse-power and 15.5 knots. Of this the Germans are naturally very proud.

Their writers, pleased with these results, point to the fact that Germany is poor in *means* to attract distinguished technicians to her arsenals, ship-yards, etc., while England has had at her disposal illimitable wealth. To illustrate: The chief constructor in England's marine gets 41,000 marks ($10,000) yearly, Germany's 10,000 marks or $2,500; the director of one of England's technical, marine wharves 15,000 marks, one such in Germany 7,300 marks. That Germany's technicians turn out better results is proof positive of a better, more suitable, fundamental, technical training, and of honest, ambitious, faithful work.

How does Germany do this? How is it she is constantly achieving such results, not only in her marine, but in her machine, shops of every kind? How is it that she can so soon make herself independent of England and the United States in the matter of all kinds of machinery? By the "suitable, fundamental, technical," "zweckmäsig und gründlichen" training obtained in her Industrial, Industrial Art and Technical schools. Give us such schools and we can laugh at opposition. *Chemnitz, Germany.*

Gyles Merrill, a well-known Vermont railroad man, and formerly general superintendent of the Central Vermont, died at his home in Haverhill, Mass., Wednesday, of pneumonia. His connection with the Central Vermont began in 1859 and continued until ill health compelled his resignation in September, 1873. At the time of his resignation he was the manager of a network of 15 railroads extending into Vermont, New Hampshire, Massachusetts, Connecticut, New York and Canada, and employing more than 5,000 men.—*The Vermont Phœnix.*

MANUFACTURES.

The steam-mill of W. E. Corn, of Windham, Vt., was recently destroyed by fire.

The Williams Furnace Co., capitalized at $100,000, has been organized at Muscatine, Ia.

The McDonell Rolling-mill Co., of Toronto, with a capital of $195,000, is about to organize.

The New Albany (Ind.) Steam Forge and Rolling-mill Co. will start soon after a long shut-down.

The Indianapolis Stove Company is running full time and working 90 men. Its usual force is 130 men.

The Essex Paper-mill, at Bloomfield, N. J., which was closed some months ago has resumed operations.

The Chicago & Northwestern Railroad Company has made a reduction of 16 cents per ton on freight rates.

At the Gautier steel department of the Cambria Iron Co., of Johnstown, Pa., over 1,000 men are now working over-time.

The Etna Standard Iron Co., of Martins Ferry, O., has been started up. The prospects are good for a long and steady run.

The Indiana Car and Foundry Company has 160 men at work. It is now working on a contract to build 250 refrigerator cars.

The entire plant of Andrews Bros. & Co.'s mill, in Youngstown, O., has been put in operation. The bridge works will also resume.

The East Lebanon (Pa.) Iron Co., whose plant was burned last April, started recently, after having rebuilt with improvements.

L. E. Crosier & Son have begun the building of a new factory at Hadley, Mass., and will put in new steam engine and other machinery.

The Ætna Iron Works, St. Louis, Mo., has been formed, with $10,000 capital. Incorporators—Edwin A. Sheble and Edgar A. Sheble

The large machine and wire works of W. H. H. Sisum, at Belleville, N. J., has been started up, after having been closed for several months.

The Memphis Car and Foundry Co., Litchfield, Tenn., has been formed with $600,000 capital. Incorporators—Calvin F. Collins and Louis C. Haynes.

Campbell & Zell Co., Baltimore, Md., are increasing the output of their plant, and will purchase—new or second hand—planers, lathes, drills, bolt cutters, boring-mill, plate planer, punches, rolls, etc.

The Niagara Cycle Fittings Co. has been organized to manufacture bicycles in Buffalo, N. Y., with capital, $10,000; directors, J. W. Parker and Kate P. Parker.

Lee's cutlery shops at Northampton, Mass., started up recently with an increased number of hands, as several large orders for goods have been received within a few days.

The Putnam Machine Company, of Fitchburg, Mass., has received a large order for machinery, and a resumption of full time, with their full complement of help, is expected.

The Caldwell Lawn Mower Co., of Newburgh, N. Y., which recently started, has now a full force of men at work, and in a few days they will be turning out 100 lawn mowers a day.

The Lodge & Davis Machine Tool Co., of Cincinnati, O., have received an order from the United States Government for machine tools to be used at the Mare Island Navy Yards.

The Greenswood Co., of New Hartford, Conn., resumed operations recently after an idleness of two weeks. About 1,700 hands are given employment and there has been no cut in wages.

The Warren Foundry & Machine Company, of Phillipsburg, N. J., is now employing its entire force of 350 men. The American sheet-mill, in same place, employing 160 hands, resumed on February 1.

Wells & Coutan Co., Limited, 29-31 Gold street, New York, issue a circular—at least it is a circular disk—setting forth the fact that they are making a line of single bell chime whistles, of which they will send price list on application.

McKinnon Brothers, who own the Sheridan mine at Iron River, Mich., have reduced the royalty from 30 to 20 cents per ton on iron ore, and it is said the other freeholders in the Lake Superior iron region will do likewise in the immediate future.

Wallace Electric Company, 104 Michigan avenue, Chicago, Ill., has been organized for the purpose of doing a general business in electric goods as manufacturers and manufacturers' agents. The members of the firm are men of large experience in electrical matters.

The improvements at Homestead the past year and still in progress will have cost when complete about $3,000,000. The new armor plate press will be ready for business in probably six weeks. Among other additions is a machine shop and appurtenances 1,000 by 180 feet.

Henry C. Ayer announces by circular that he has sold out all right, title and interest in the firms of Pedrick & Ayer and H. B. Underwood & Co., and connected himself with Henry C. Ayer & Gleason Co., Philadelphia, Pa., to do a general machine business, manufacture tools, etc.

The Portland Company, Portland, recently shipped a large digester to the J. & J. Rogers Co., of Au Sable, N. Y., and three sections of the large iron penstock to the Poland Paper Co., Mechanic Falls. It is hoped the works of the company will start on full time the first of next month.

The West Point Foundry at Cold Spring, Newburgh, New York, has obtained from the U. S. Government an order for a large number of gun carriages and caissons, and the work of constructing them will take from two to three years. This will insure the employment of 500 men at the foundry.

For a long time the air of Waltham, Mass., has been filled with rumors of shutting down at the American Watch Factory for an indefinite time. The anxiety became so great that President Fitch has given out a statement that the factory would shut down for one week only, after which it will run on full time.

Warner Bros.' factory, Bridgeport, Conn., resumed operations on the 14th ult., and from now on the 1,200 employes will probably have work 10 hours a day and six days a week. The Wheeler & Wilson Manufacturing Co., whose works have been closed since the last of the old year, opened and work was resumed in all departments.

Dean Brothers, of Indianapolis, steam pump manufacturers, have 80 men at work, about one-half their usual force, at nine hours a day. They have let the contract for the new engine and boilers for their new shops on the corner of First street and the Big Four tracks to the Atlas Engine Works. The engine is to be of 100 horse-power.

The Grosvenor-Dale Co., at Grosvenor-Dale, Conn., are building their new coal sheds of iron. The construction is designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn., and is so arranged that the coal can be unloaded direct from the cars into the pockets without handling. The Grosvenor-Dale Co. expect to save a large amount of money each year by saving the expense of handling their coal the second time.

The rod mills of the Illinois Steel Company, Joliet, Ill., have started up, giving employment to 200 men. The converters have been run for one week with 900 men, and more will be put on this month. Next Thursday, after a stoppage of two years, the rail-mill will start up, and it is now thought that the mills will run steadily for at least six months. Many smaller concerns are beginning to run full time, and manufacturing business in this locality is brightening up.

W. H. Anderson & Son, Detroit, Mich., write us: We would be pleased to receive circulars of pipe boilers, engines and dynamos from any of your customers, as we are considering the advisability of putting in an electric light plant in connection with our works to light surrounding stores and factories. We will very likely use a 400 to 500 light generator with engine and 150 to 250 light generator with engine and 100 horse-power boiler, in addition to our present engine and boiler.

Business is reported to be picking up in Worcester, Mass. The carpet-mill of M. J. Whitall, at South Worcester, which has been running on short time on reduced wages, started up recently on full time, giving employment to about 400 persons. The Worcester Carpet-mill will start up their spinning room on full time in a week or ten days. This will employ 200 hands. Orders are coming in better at the Washburn and Moen Wire-mill than they have for months, and additional departments have been started up.

A Buffalo (N. Y.) dispatch of January 27th says: A steel rail plant, with a capacity of 100 tons per day, will be soon started in Tonawanda. It will be known as the Reese Iron and Steel Company, and Mr. Abraham Reese, of Pittsburgh, will be its manager, while the capital will be supplied by a syndicate of New York, Pittsburgh and Buffalo capitalists. The works will cover about eight acres and will employ 500 to 700 men. The works will be confined in the main to the manufacture of light grades of steel rails, like those used in mines, lumber camps, etc., which will be produced from old iron rails by a process invented by Mr. Reese.

The employes of the H. O. Nelson Mfg. Co., of St. Louis, are in good spirits. This concern is conducted on the profit-sharing plan, and for the last ten years the workmen have received annual dividends. In August last, when the financial stringency was making itself manifest, they accepted without demur a cut of 25 per cent. in wages. On the 17th ult., under resolution of the Board of Directors, a dividend of 7 per cent. was distributed, and, in addition, the loss by the cut in wages was returned in full in cash to each employe. This satisfactory condition of affairs was brought about by a revival in the business of the corporation.—*Iron Age.*

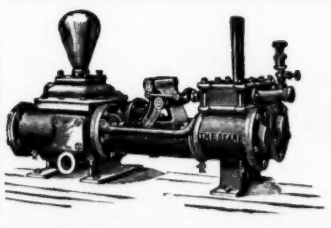
"MASON REGULATOR CO.,
BOSTON.

GENTLEMEN: Enclosed find order for $2. Please send me 'Engineers' Catechisms' for this amount. I am going out as soon as the books come, and will be out some months. Have orders for half a dozen in town here, and this without any solicitation; young men have seen the book on my desk.

I am, respectfully yours,

(Signed) W. D. TOMLIN,

Minnesota State Inspector of Steam Boilers."



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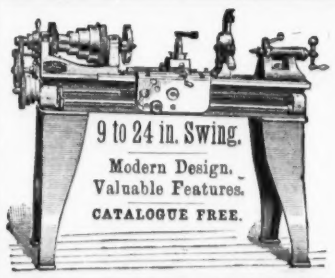

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NEW YORK JERSEY CITY CHICAGO PHILADELPHIA BOSTON LONDON

A Joliet, Ill., dispatch of January 23, says: "The Illinois steel-mill started up yesterday with 900 men, and it is thought that the mill will run steadily. Next Monday the rod-mill of the Illinois Steel Company, after lying idle for a year, will start, and 200 men will be put to work in that department. On February 1, Lambert & Bishop's wire-mill, a branch of the Consolidated Steel and Wire Company's Works, will start up, giving employment to 800 men. The Phœnix Horseshoe Company's Works and several other small factories will start up about that time. Affairs begin to look better, and the merchants as well as the laboring men are rejoicing over it."

Jenkins Bros., 71 John street, New York, have issued a new catalogue which engineers and others interested should send for, as it is intended to supersede all previous lists. It is very completely illustrated with cuts of valves for a great variety of purposes and in various forms, stop valves, globe and gate, safety valves, back pressure valves, check valves, air valves, radiator valves, etc.; also steam traps, pressure regulators, pump governors, gauge cocks, "Jenkins" packing, and a variety of other supplies. Improvements have been made in their goods during the past year, and for this and other reasons the new catalogue should be obtained and the old one thrown away.

The *Tradesman*, Chattanooga, Tenn., in its review of the industrial situation in the South for the week ending January 22d, reports that the newly established industries in the Southern States continue to steadily increase in number and in importance. The report for the past week aggregates a larger number than has been noted since May, 1893, and they include almost every branch of industry. Enlargements of existing manufactories have increased in equal proportion, and inquiries for new machinery continue active. *The Tradesman's* reports, received from all parts of the South, concur in the statement that the settlement of the tariff question will be at once followed by an extensive revival of industrial interests.

There has been a misstatement in some of the papers regarding the state of affairs at the works of the Morgan Engineering Company at Alliance, O., and the facts as they appear from the statement made by the company are, that instead of the works being run with half the usual force and about one third time they have been running night and day during the general business depression and are still doing so with nearly the full complement of workmen. The plant will continue to run in this way for some time to come, even if no further orders than those on hand are received. A few hands have been temporarily laid off from time to time, not on account of lack of work but because of inability to get out needed designs and patterns.

A new company has been formed in Jersey under the title of the General Mfg Co. The capital is $2,500,000. The offices of the company are No. 911 Havemeyer Building, Church and Cortlandt streets, New York. The officers are Abner W. Pollard, president; Robert S. O'Loughlin, vice-president; Louis A. Pollard, treasurer; Ed. G. Kidder, secretary; I. B. Cleaver, business manager. The manufacture of graphite bearings, wheels and axles, pulleys and hangers, etc., will be one department. Foundry, machine shop and boiler shop will be another department, where particular attention will be given to the manufacture of waterworks plant and hydraulic engineering generally. The full high pressure System, as introduced by Ernest W. Naylor (member of American Society of Mechanical Engineers) into this country, will be made a specialty. Mr. Naylor undertaking the superintendence of this department, other manufactures will be added as may be deemed advisable. Works will be built at Bound Brook, N. J., as speedily as possible.

Machinists' Supplies and Iron.

NEW YORK, February 3, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $13.00 to $14.00; No. 2, $12.50 to $13.25; Gray Forge, $11.75 to $12.50. Southern brands of good quality are obtainable at $13.00 to $14.00 for No. 1 Foundry; $12.00 to $13.00 for No. 2, and $11.25 to $12.00 for Gray Forge.

Antimony—The market is improving. We quote L. X., 9⅜c. to 9.40c.; Cookson's, 10c. to 10⅛c.; Hallett's, 8.95c. to 9c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 70c. to 71c.

Copper—The market is quiet and steady. We quote Lake Copper at 9.80c. to 10c. Casting Copper is held at 9⅛c. to 9¼c.

Lead—The market is firmer with an increased demand and little offering to meet it. Good commercial brands are being sold at about 3 85c. to 3.40c. for New York delivery.

Spelter—The market is improving. Holders are firm in their views and ask 3.65c. to 3.70c. for New York delivery.

Tin—The market is weak without any improvement in demand. The best price bid is 19.70c., and although 20c. is asked in a nominal way business in small lots has been done at 19.80c. to 19.85c.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Foremanship by one of exp; engines, pumps, or gen. repairing. Indicator, AM. MACH.

An experienced foreman pattern maker wants sit'n; highest refs. as to ability. Patterns, AM. MACH.

Comp. draftsman exp'd in eng., boilers and general mach. wants position. Box 3, AM. MACHINIST.

Draftsman of six years' experience, wishes position; references. Box 7, AMERICAN MACHINIST.

Tool maker, 33, dies, tools and punches, wants position. Box 8, AMERICAN MACHINIST.

Draftsman (Swede,) 5 years' experience, desires position. G. B., AMERICAN MACHINIST.

Pattern maker, exp'd first class, wants sit. as foreman or otherwise. Moderate Wages, AM. MACH.

Wanted—Detail draftsman on electrical machinery, one with shop exp. preferred; state age, exp., and salary expected. Box 11, AM. MACHINIST.

Wanted—Thoroughly practical draftsman on the Corliss engine. Address stating age, experience, and salary required, Box 6, AMERICAN MACHINIST.

Machine shop foreman, 34, and a pusher desires a change, engines stationary & marine; also pumps and general machine work. Steam, AMER. MACH.

Mechanical eng. and designer, with experience in marine engines and boilers, high grade Corliss and hoisting engines, is open for engagement; best references. Address T. U 33, AM. MACHINIST.

Wanted—Situation by expert all-round machinist as foreman, assistant or first-class machinist; Southern or Western States preferred. John T. Usher, Box 10, AMERICAN MACHINIST.

Die maker and machinist, experienced in the manufacture of sheet metal dies, machinery and goods, wants position as foreman. Address Box 12, AMERICAN MACHINIST.

Wanted—Machinist, competent to manage either the shops or office business of a machine shop and foundry, well equipped and well located; one who can put in a small working capital preferred; company chartered. P. O. Box 463, Dalton, Ga.

Wanted—Mfg. establishment wants for superintendent of screw machine department first class man fully posted on latest methods for bicycle & electrical as well as general screw work. Address Erie, AMERICAN MACHINIST.

Wanted—Situation as foreman or superintendent of machine shops; have held both positions; experienced on Corliss engines, mining & gen. mach'y; 38 years of age; 22 years' practical experience; first-class references. Address Box 4, AM. MACHINIST.

Wanted—First-class machinist, who has had practical experience in designing and making tools for a milled machine screw factory; rising young man preferred; must be temperate, reliable, and well recommended; state salary, experience, age, etc., John Morrow Machine Screw Co., Ingersoll, Ont., Canada.

(*Continued on page* 14.)

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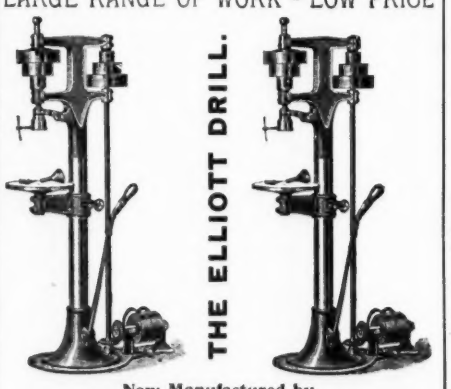

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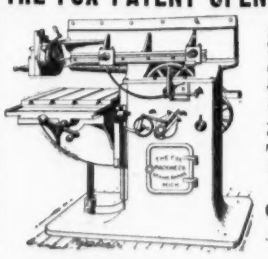
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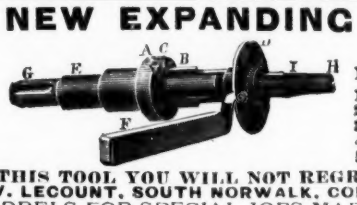

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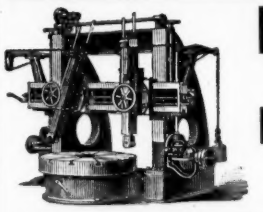
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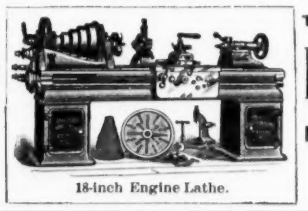
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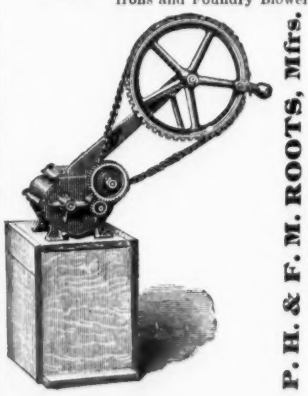
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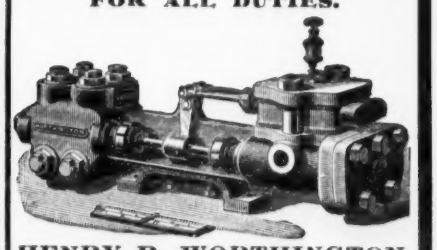
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Open to engagement, a thoroughly pract. and theoretical mech. & hydraulic engineer; designer of hydr. plants a specialty; expert in the mfg. of seamless steel tubing, drawn steel articles, hot or cold, and hydr. forgings; ref. Box 9, AM. MACHINIST.

A well-educated mechanical engineer whose experience covers an extensive practice in engineering, manufac'g, etc., & whose qualifications are of the highest, desires engagement as manager, supt., or other responsible position; location no object. A. M., Box, 589, Ravenswood P. O., Chicago Ill.

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✢ MISCELLANEOUS WANTS ✢

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Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz. Schumacher & Co., Cincinnati, O.

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We will pay 50 cents each for copies of the AMERICAN MACHINIST of December 4, 1886 issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Michigan Agricultural College offers instruction in mechanical engineering—four years' course; the average expense of attendance at the college is $135 per year; the course is arranged so as to give students an opportunity to earn a portion of their expenses. Address Mechanical Department, Agricultural College P. O., Mich.

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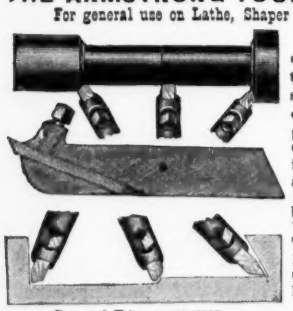

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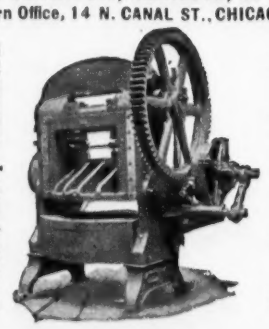

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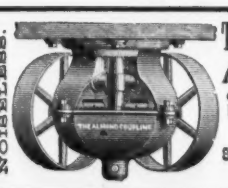

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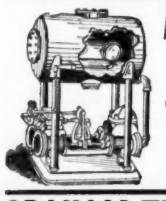

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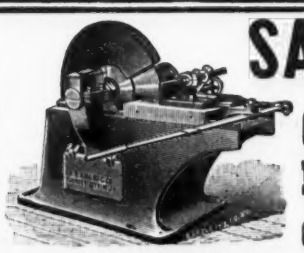

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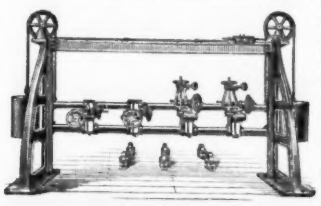

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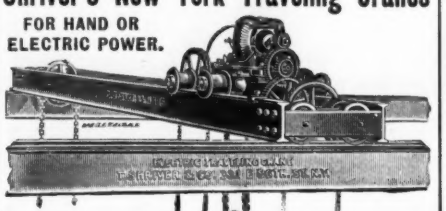

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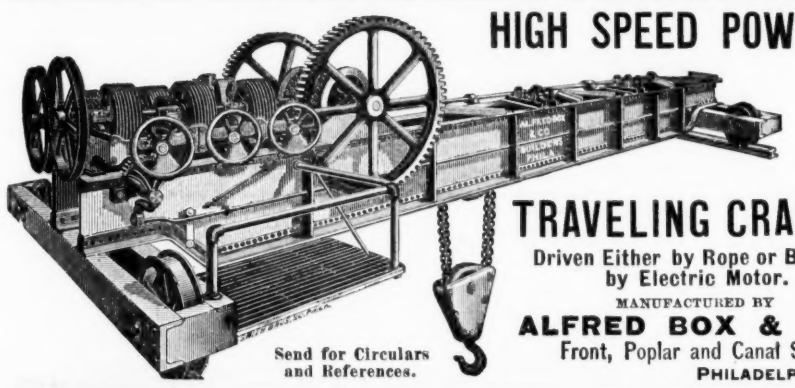

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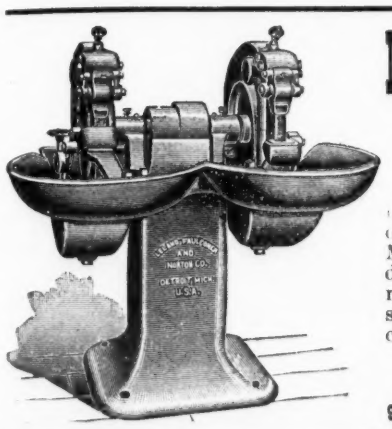

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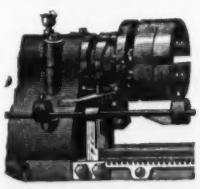

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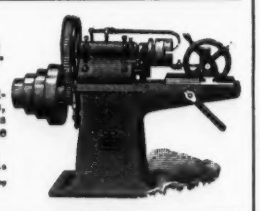

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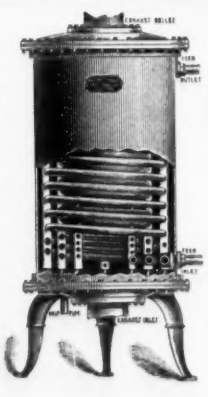

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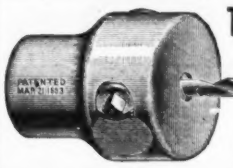

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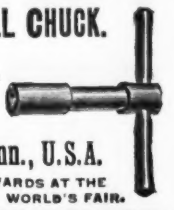

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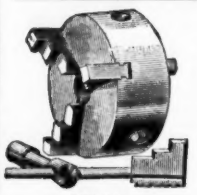

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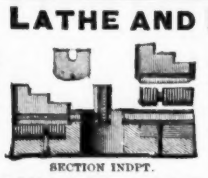

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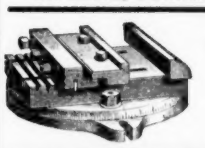

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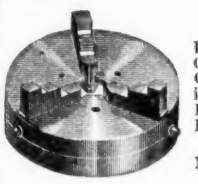

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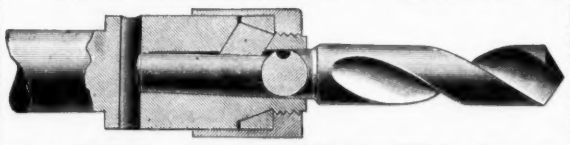

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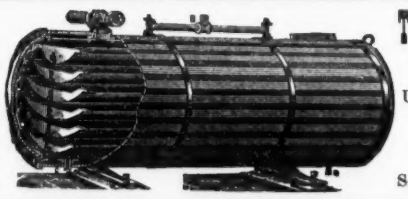

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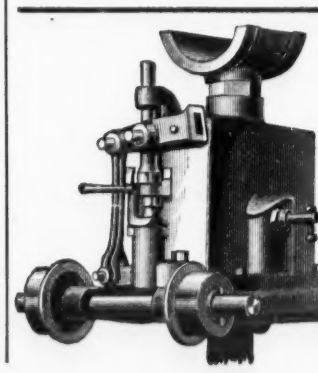

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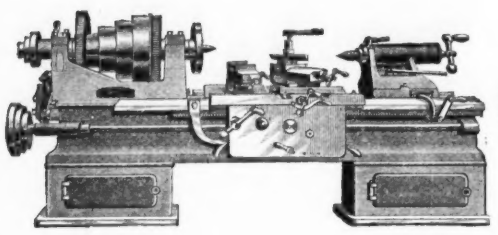

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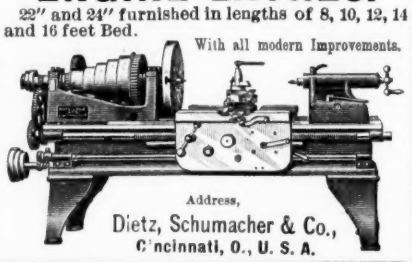

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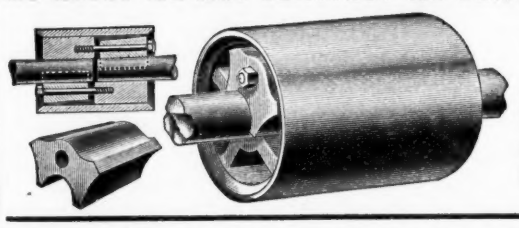

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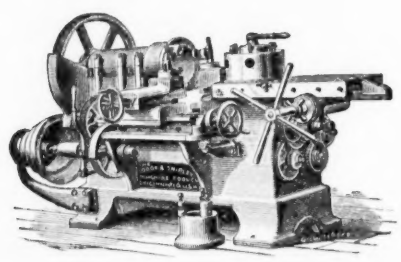

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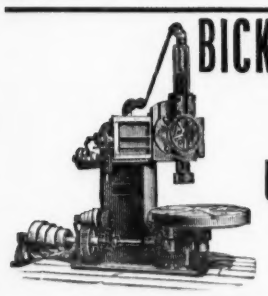

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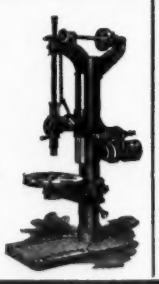

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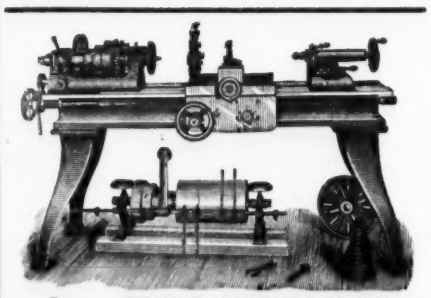

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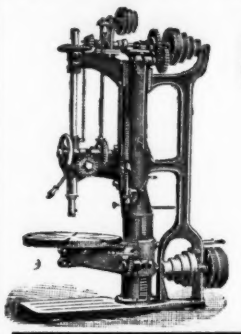

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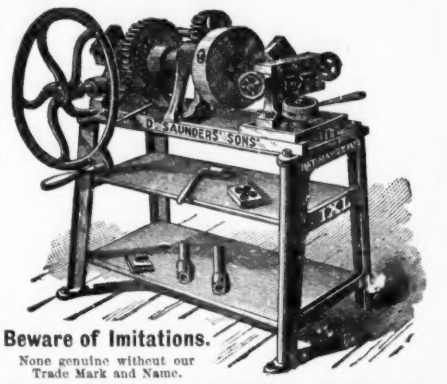

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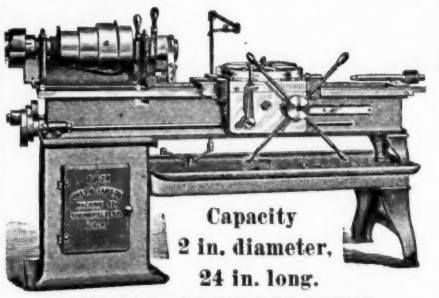

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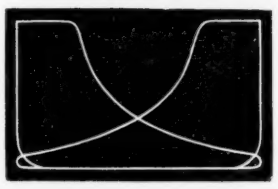

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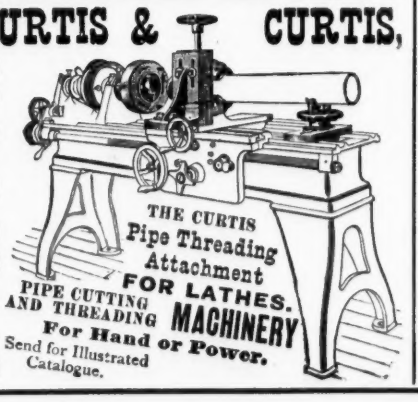

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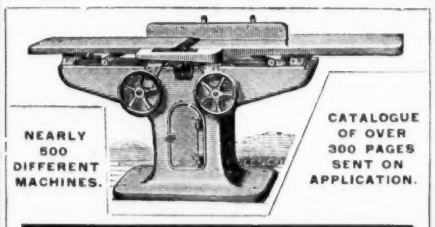

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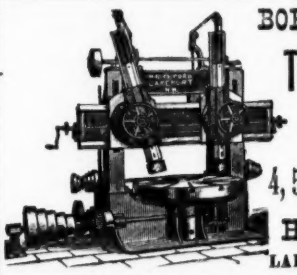

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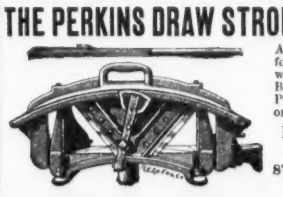

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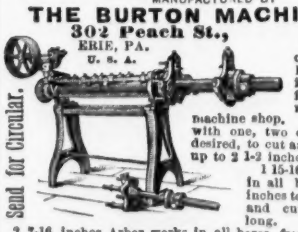

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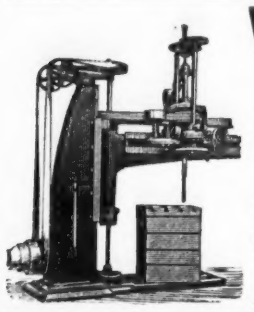

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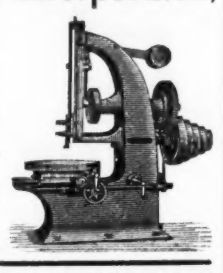

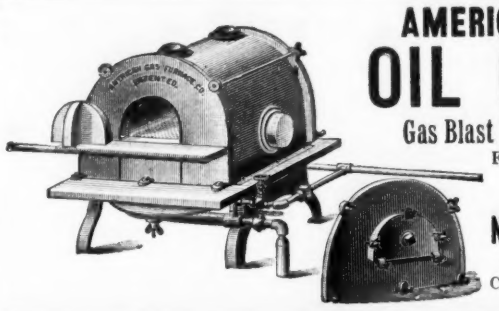

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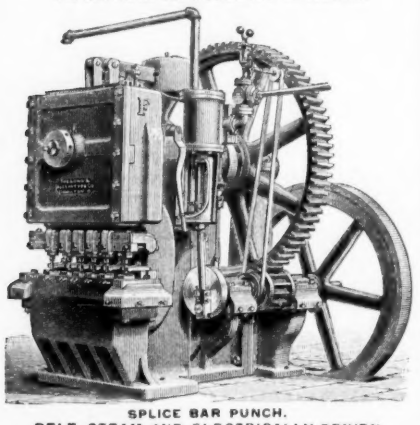

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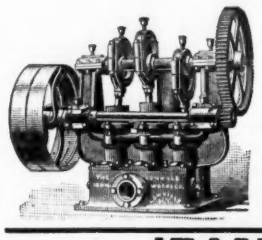

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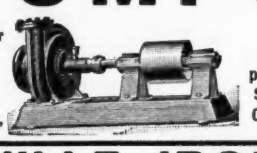

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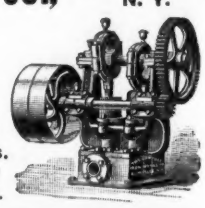

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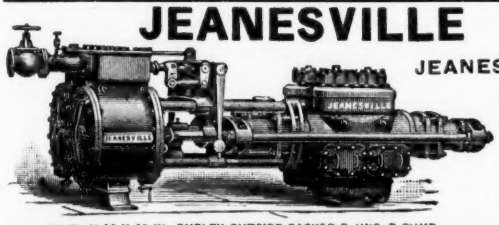

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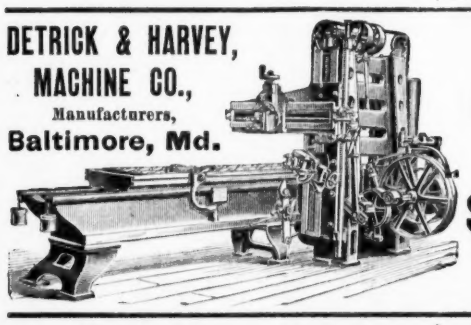

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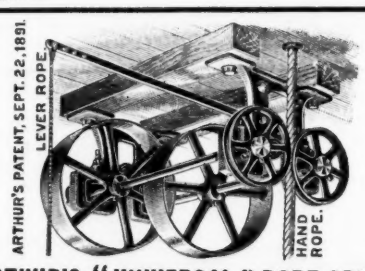

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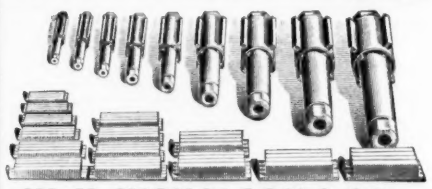

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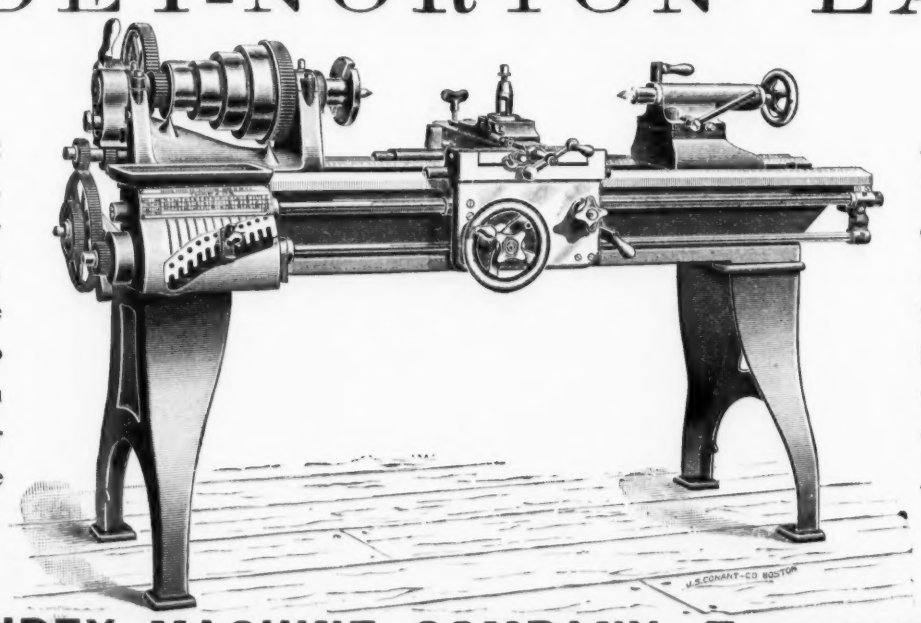

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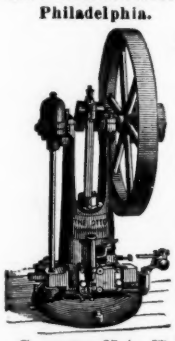

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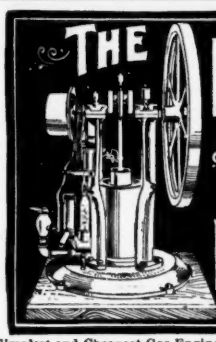

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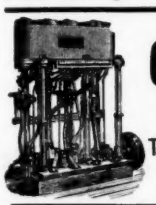

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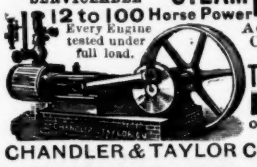

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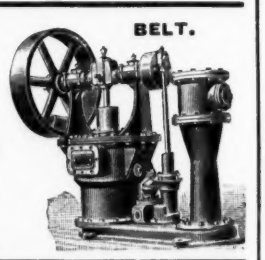

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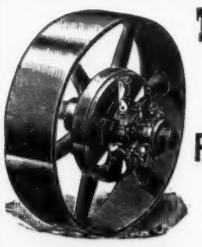

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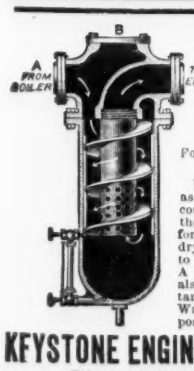

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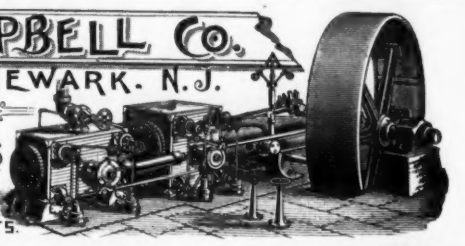

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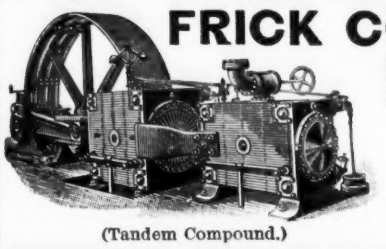

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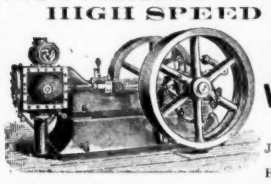

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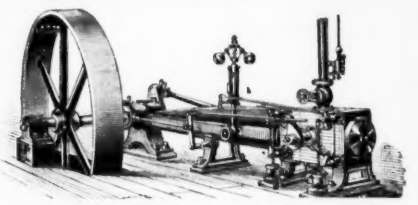

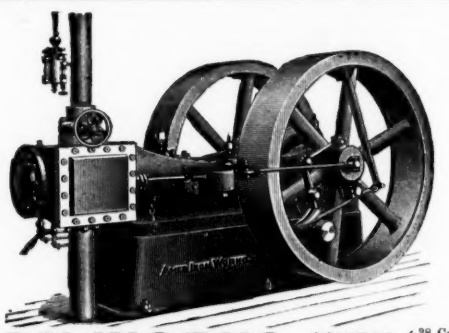

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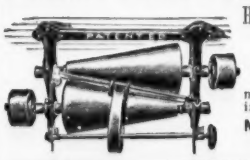

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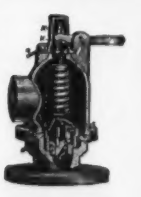

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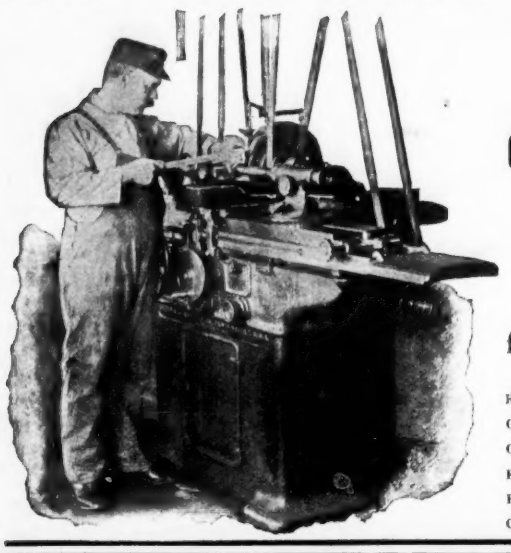

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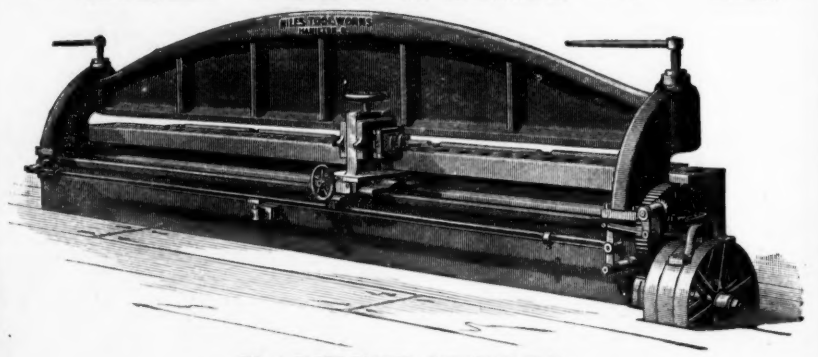

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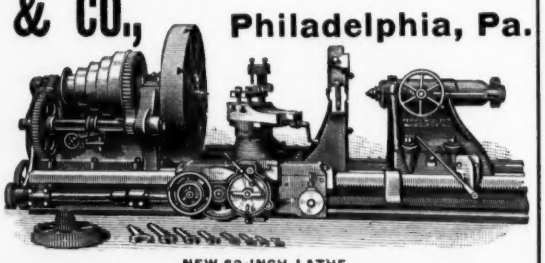

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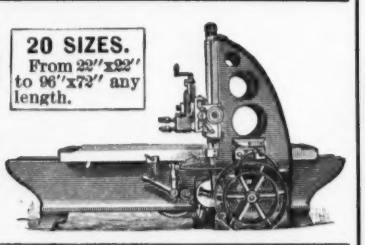

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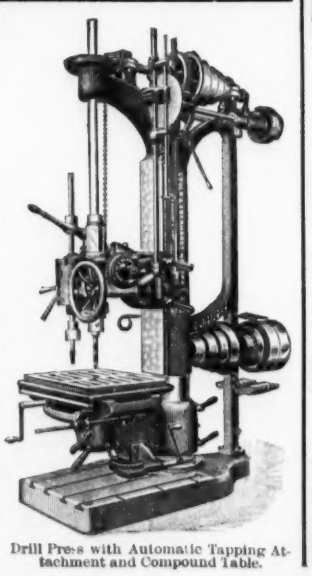

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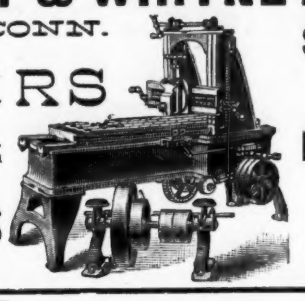

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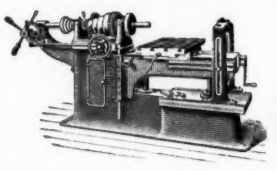

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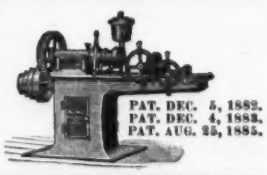

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